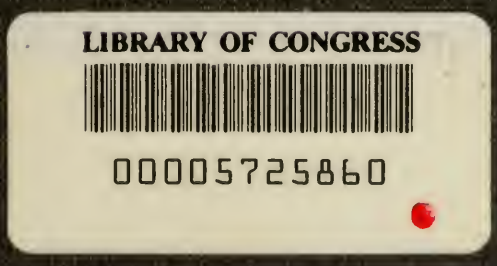


The Art

OF

VULCANIZING

Wood & Lumber.

THE MOST VALUABLE DISCOVERY OF THE AGE.

THE

ART

OF

Developing, Curing, and Preserving

WOOD AND LUMBER

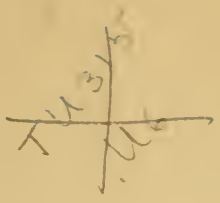
BY

VULCANIZING

United States vulcanizing wood and lumber company

Wood and Lumber rendered Tougher, Stronger and more Beautiful; thoroughly Cured and Prepared for use; and also Preserved from Decay in from three to six hours. No Sap is driven out; no Foreign substance is introduced; the Natural elements of the Wood are Retained and Utilized. The Process Simple, and Inexpensive, requiring no Skilled labor, no Complicated Machinery.

ALBANY
MUNSELL PRINTING HOUSE
1882.



United States Vulcanizing Wood and Lumber Company.

CAPITAL STOCK, $3,000,000.

Divided into 30,000 Shares of $100 each.

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THE ART

— OF —

VULCANIZING WOOD AND LUMBER.

"The Man who adds a Science, or an Art,
Or new Invention, practically wise,
Leads the great host."

Of all the products of the bounteous soil of our country timber is the most valuable, and enters most largely into our wants. Its conversion into wood and lumber for our manifold uses constitutes an industry of the first importance.

Nothing contributes more to the comfort, prosperity, and material greatness of this nation, than wood and lumber.

In every department of business on sea and land, in every stage of life from the cradle to the coffin, wood in some shape is an absolute necessity. No art can flourish, no industry prosper without wood. Although required for purposes almost countless, and in quantities almost measureless, all wood and lumber must go through some sort of treatment to prepare it for use. Wood in its natural or green state, and filled with sap or fluid matter, is liable to important changes, not only of form, but in its very substance and structure, which greatly impair its usefulness.

These are due to the influence of the various conditions of atmosphere to which it must necessarily be exposed. Any loss of fluid matter, by exudation or evaporation when exposed to heat, will cause the wood to shrink, and absorption, when exposed to moisture, will cause it to swell. From shrinking and swelling, generally accompanied by warping and cracking, the wood will lose its shape and form, however beautifully and usefully it may have been faced, fashioned, and fitted by skill and labor.

Again, the sap or fluid matter of green wood contains certain nitrogenous, organic compounds known chemically under the general name of albuminoids, and these substances in their natural state are active in inducing and favoring rot. The gummy, sugary matters found in these compounds under certain atmospheric influences are liable to fermentation, which once begun spreads with great rapidity, until by decomposition the structure, and all traces of the original organization of the wood are destroyed.

Thus the sap or fluid matter in its natural state, as the original source of decay, and the prime cause of the other changes in wood, came to be considered as worse than useless, and as something *to be gotten rid of;* and the methods hitherto employed for preparing wood and lumber for its various purposes have been, for the most part, mere devices for driving out, *for getting rid of* the sap or fluid matter.

Seasoning of Wood and Lumber never a Success.

Seasoning by what is known as the "natural process" was the first adopted for this purpose, and consisted in a slow drying out of the fluid matter of the wood by exposing it to the action of the open air. As the result sought could only be effected by an exposure of the wood for many seasons, this mode of treatment was termed "seasoning," and the treated wood was called "seasoned."

So generally, and for so long a time has this "natural process" been in use, that the driving out of the sap by any means is called "seasoning," and wood which has parted with any portion of its sap is designated as "seasoned." While by "seasoning," some of the putrescible substances and fermentable principles are expelled, and the operation of the causes of decay is thus counteracted, or postponed to some extent, its chief object is to put wood into a condition to *keep its shape and form*.

The impossibility of supplying a constantly increasing demand for seasoned lumber, by the slow natural process, has led to the invention and introduction of various methods of "seasoning" more rapidly by artificial means.

Among these are many ingenious contrivances for steaming and boiling the life, elasticity, and strength

out of the wood, and for warping, and cracking, and otherwise injuring it by currents of hot air.

For forcibly extracting the sap, wood is sometimes placed in a vertical iron cylinder standing in a cistern of water closing the cylinder at top: the water is then heated and steam used to produce a partial vacuum, the sap relieved from atmospheric pressure oozes from the wood, and being converted into vapor passes off through a pipe provided for the purpose.

Then again when time is precious, and strength of fibre of no consequence, wood is often submerged in running water in order to get the fluid matter out of it. This treatment is based upon the idea that sap, by reason of the matters which it holds in solution, is more dense than water, and not so easily evaporated. Hence when the sap is dissolved and washed out, the water which in a measure takes its place, is readily evaporated from the wood by a drying process. The effect of water is to dissolve much of the substance of the wood, thereby impairing its strength, and rendering it brittle and unfit for many purposes.

Another of the rapid artifical methods of "seasoning," and the one most generally employed in this country is "kiln-drying." This consists in placing the wood in a chamber, and subjecting it to the action of hot air, or super-heated steam, and by a slow process of distillation the sap is expelled. The wood loses much of its life and strength, its fibre is rendered brittle, and the depleted pores readily absorb moisture; then the wood swells, and when that moisture is expelled, the wood shrinks, and it continues thus to swell and shrink

alternately with the variations of atmospheric conditions. The wood has had its fluid matter driven out, and it is what is called "seasoned," but it certainly *will not keep its shape and form.*

Notwithstanding the increased and increasing demands for lumber, and of the great urgency, the necessity for the more rapid artificial means of seasoning, the old fashioned "natural process," the one longest in use, introduced probably as early as the building of the Ark, is, strange to say, both in this country and in Europe, the most generally approved, and most generally used at the present day.

This process is therefore entitled to more than a passing notice. It should be examined in detail, its mode of application, its cost, the time required, its effect, all its merits and demerits should be carefully considered, that we may see how little we have advanced in this age of progress in a business of such magnitude and importance as the "seasoning" of lumber.

This treatment in the *natural* way, as it is termed, and as heretofore explained, is a slow process of desiccation by exposing the wood or lumber to the action of the open air.

The green wood or lumber is stacked or piled with intervening strips so as to permit the air to circulate freely between the pieces. The sap, or fluid matter (which in its natural state is highly soluble by water) is dissolved by the moisture of the atmosphere, and when thus diluted is more readily evaporated. In the course of time, the loss in the weight and measurement of the wood will show that much of the fluid matter has been dissolved and expelled, while that portion of the wood or lumber, which has been in contact with the air, will

seem dry. But when a few shavings are taken off the outside, and a new surface is exposed, the fresh fluid matter, not before in contact with the air, will in its turn be dissolved, diluted and evaporated by the action of the atmosphere, and the wood or lumber from its loss will again shrink, and such will be the result even after it has been kept for half a century.

One of the greatest objections to the "natural process," is, that it is too slow. The great length of time required in the operation for proper treatment necessitates the carrying of heavy stocks of lumber, and a large outlay of capital and loss of interest, to which must be added large bills of taxes and insurance, besides a very considerable loss of material by the shrinking, warping, cracking, and the rotting of the lumber.

The wood and lumber is tougher and stronger, and in many respects better than that treated by the artificial methods described, but like all "seasoned" lumber it is porous, and from inequality of shrinkage is wanting in uniformity of structure, is rough and uneven in grain and surface, and requires thorough priming before being painted, as well as elaborate filling or sizing before it is varnished or polished. The necessity for this labor and expense results in a great measure from driving the sap or fluid matter out of the wood.

The "open air" treatment is *too slow*, and the "more rapid artifical" processes are also *too slow*, and all of them combined fall far short of supplying even with imperfectly seasoned material the demands of this rapid age.

The truth is all these processes for "seasoning" are failures. They are based upon error, are wrong in theory and practice. The idea of driving out the fluid

matter, and thus depriving wood of essential constituents and useful properties is absurd. The attempt to produce a condition of wood that is wholly unlike its living state is contrary to common sense, and at war with nature.

The Preservation of Wood.

By the rotting of wood, which we see around us wherever we turn our eyes, there is not only a loss of the material, but of the labor and skill by which it has been converted to our uses. In America, until recently, timber has been so abundant, and lumber so cheap, that but little thought has been given to this constant and wide spread destruction of wood, and the immense loss thus annually incurred

But with the march of civilization, the increase of population, and the multiplied necessities and requirements of wood and lumber for all the arts and industries, the great forests of the country have disappeared so rapidly, that the possibility of a scarcity of wood is not only recognized, but the question of a sufficient supply, in the near future, has become a serious problem, and the necessity of its preservation from decay is beginning to be realized.

More than fifty years ago, the necessity for preserving wood and lumber became so apparent in European countries, that many scientists and inventors engaged in the investigation of the subject, and in efforts to discover some means of accomplishing that important result.

As early as 1832 Dr. Kyan demonstrated the fact, that the decay of wood was due to the fermentation of the albumen of the sap, and he adopted the method of injecting into the wood a solution of corrosive sublimate, for the purpose of coagulating the albumen, and thereby

preventing fermentation and decay. Practical experience proved it a success, and he received from the English Government a patent for his discovery.

This process proved too expensive for general application, and the wood treated by it was found to be unfit for many purposes.

Subsequently Sir Wm. Burnett, an English inventor, discovered that chloride of zinc, which was not so expensive, would accomplish the same results, but it was found that this material rendered the wood brittle. "Burnettized" wood has been used to some extent in this country, especially in bridge timbers, many of which, on account of impaired strength, have had to be replaced.

Following these discoveries, Payne, Margary, Boucherie, Reid, Moll, and other English and French inventors took patents for the use of sulphate of copper, iron, upion, and pure creosote, tannin and hydrocarbon oils, all making the same claim, viz: *the coagulation of the albumen of the sap.*

The modern "*creosoting*" process, now in use for some purposes, was an invention of John Bethell of England, and first patented by him July 11th, 1838. It consists in impregnating the wood with oil of tar and other bituminous matters containing creosote, which is done in the following manner: the wood is placed in a closed iron cylinder from which, by the use of a pump, the air is exhausted until a vacuum is produced. This is done to draw out the air and superabundant moisture contained in the pores of the wood, that is, to deplete the pores and make room for the oil. The oil, warmed to a temperature of about 120° Fht., is then introduced into the chamber, and by means of a pump

is forced into the depleted pores of the wood by a pressure of from 150 to 200 pounds to the square inch.

The claim for this process is not only the coagulation of the albumen of the sap by the creosote, but also the filling of the pores with oil, so that the wood will not absorb moisture. The necessity of producing a vacuum, of displacing some of the natural fluids of the wood, and of heating the oil as a preparation for its introduction makes the process very elaborate and tedious.

Another serious objection to "creosoting," which obtains as to "Kyanizing" and "Burnettizing," also, is that the machinery is complicated and costly, requiring scientific control and skillful handling, and the materials employed are too expensive.

Practical experience has shown that a foreign substance cannot be forced into wood while its pores are filled with its own fluids. Hence the absolute necessity of driving out, or drawing out the sap, and in some way depleting the pores of the wood. In other words, the wood must be carried through some process of seasoning before it can be creosoted.

And as the pores of heart-wood are filled with elaborated sap which cannot be drawn out or displaced, such wood cannot be impregnated with the oil by the means employed. Only the sap-wood therefore of many kinds of timber can be creosoted.

Mr. Bethell himself states that "It is impossible to drive the oil into the heart-wood; only the sap-wood can be impregnated."

Only such woods can be properly treated as will, after the expulsion of their own fluid, take up a large quantity of creosote oil.

Another objection to the process is that all timber must be shaped, bored and scarfed, etc., before treat-

ment, that timber once converted should not be cut in any way.

Again in creosoting there is difficulty frequently in obtaining oil of such specific gravity as will admit of ready penetration even into sap-wood, owing to the fact that chemical works are extracting from the oil every ingredient that can be utilized for other purposes, leaving only the residuum for use in the treatment of wood. Hence the growing scarcity and increasing price of the creosote oil.

Some times only thick oil can be obtained, which cannot be used until, by application of steam, it has been melted, and even then it cannot be forced into the timber without difficulty.

After satisfactory practical tests, the effectiveness of Bethell's process has passed out of the region of theory and experiment. It is now an acknowledged fact, that wood of any kind, which, by preparation, can be rendered susceptible of a sufficient impregnation with creosote oil, will certainly be preserved from decay.

It should be borne in mind, however, that the wood and lumber treated by this process is only fit for piles, ties, bridge timbers, fencing, and outside work, and cannot be used for mechanical purposes, and for inside work, because of the strong, offensive odour.

But in spite of its limited uses and elaborate methods, in spite of the great complication and cost of the machinery, and the difficulty and expense of getting a sufficient quantity of proper material to be used, the "Bethell" process has been adopted to some extent in Europe, thus showing the great desire for some process, which will preserve the life and increase the durability of wood; and Jno. Bethell, Sir Wm. Burnett,

Dr. Kyan and others, who have demonstrated the fact that wood and lumber can be preserved from decay, deserve to be gratefully remembered.

For an American genius of our own day and generation was reserved the glory, the enduring fame of discovering in the properties of the wood itself, the elements of its development, preparation for use, and *preservation from decay:* in the forces of nature, the means of their utilization; and in "vulcanizing," the art of employing in the most effective manner these natural elements and forces.

The Process of Vulcanizing Wood and Lumber explained.

The wood or lumber is piled on a wheeled car with strips intervening as done in the lumber yard. This car when loaded is drawn into an iron cylinder of suitable size, which, when the doors are closed, is air-tight. By a system of pipes inside the chamber, and surrounding the car load of wood or lumber, steam or hot water is introduced, so as to raise the temperature of the chamber to any degree desired. A pump is employed to force air into the chamber. While the wood is being subjected to a great heat, there is such a pressure put upon it, by the air, as will prevent the evaporation of the sap. The fluid matters are not driven out, but are held in the wood by pressure until they are chemically changed, or *cured* by the heat. The evaporation of the juices of the wood being prevented by pressure, while the heat coagulates the albumen, and developes certain resinous and oleaginous substances, which, in the operation, are dispersed through and solidified with the fibres and cells. The sap, thus retained and utilized in the wood as the best and most natural filling for the pores, and cement for the fibres, makes of the woody structure a dense, dry and uniform mass, tough and strong, and preserved from fermentation and decay.

In "Vulcanizing," the chemistry of nature is made use of in developing and perfecting, preparing and preserving wood and lumber.

It is a scientific fact, that the degree of heat necessary to create ebullition, or evaporation of a liquid, depends upon the amount of pressure (atmospheric or gaseous) upon its surface. The greater the pressure, the higher the temperature required to bring the liquid to a boiling or evaporating point. Water under the pressure of the atmosphere (15 pounds to the square inch) cannot be made to boil, to expand into steam, with less than 212 degrees of heat. But if the pressure be removed, as it is when water is in vacuum, much less heat will cause ebullition and evaporation. So when water or other liquid, as the sap, is placed in a chamber and subjected to a great pressure, more than 212 degrees of heat will be required to bring it to a boiling point, and cause its escape in steam.

It is also a scientific fact, that by heat important chemical changes can be produced in almost all substances.

In "Vulcanizing" wood these principles have been utilized. An artificial pressure of 150 or 200 pounds to the square inch, equal to 10 or 12 atmospheres, is put upon the wood so as to prevent ebullition, and, consequently, evaporation of the fluid matter or sap, while, at the same time, the high heat effects a change in the substances of which this sap or fluid matter is composed. Vaporization is prevented by the pressure, and by the heat, the resinous and other vaporizable products are coagulated, solidified, and fixed in the wood, filling the pores and connecting the fibres, all being so changed and cured, as to prevent fermentation and consequent decay.

"Vulcanizing" thus perfects crude wood or lumber by the development and modification of its natural ele-

ments. When the wood has been heated to the centre, the work is done. Of course all insects, worms, and germs will be destroyed in the operation.

Time.

Inch boards should be subjected to the heat and pressure from 3 to 6 hours. For wood of greater thickness a longer time is required.

Expense.

The price of the fuel employed in producing the neccessary heat, added to the expense of handling the wood, will cover the whole cost of "vulcanizing."

Heat and Pressure.

The efficiency of the means employed, and the remarkable results accomplished by the "vulcanizing process" may be readily understood upon a moment's consideration, and a common-sense application of certain simple and well known facts pertaining to the growth of the tree, the nature of wood, and the causes of its decay.

Heat and pressure, the agents employed in the art of vulcanizing, are the simple forces by which many wonders are worked in the vast economy of nature.

In the inception, organization, growth and development of vegetable life *heat and pressure* are so necessary, that it may in truth be said, without them, we would have no wood.

Life, however excited into action by heat and moisture in the seed, could never be organized into the plumule of the plantlet without heat and pressure. Nor could that strange, but essential nucleus of life and growth, the "pithy column," be formed for every branch and stem of the plant without heat and pressure.

The crude, or elementary sap taken up by the roots, could not be converted into formative fluid, nor formative fluid into formative tissues, nor formative tissues into cellular and vascular tissues, nor the cellular and vascular tissues into flattened imperforate cells and tubular fibres, nor could these weave themselves, as woof and warp into

wood structure, and become dense, hard and firm around the "pithy column," without heat and pressure.

So, in the further growth of the plant stem, as year by year the upward flowing sap receives its chemical changes by the action of the leaf, and then descending under the bark forms a layer of woody substance around its centre, until the stem develops into the trunk of a tree ; and, as these annual formations are compressed into concentric rings of hard, firm wood, marking distinctly each year's growth, we see the results of heat and pressure ; when, in the course of time, these rings aggregate around the centre of the tree, and mature in the order of their growth ; and, when the cells and fibres, all filled and strengthened by a deposit of perfected, solidified sap, cohere firmly into a strong, tough mass, forming the dark colored and durable heart-wood, we see the wonderful results of the two great forces of nature, heat and pressure.

In its growing state wood is stronger, tougher and more elastic than when dry. Its natural fluids contain all the antiseptic elements and properties necessary to its own preservation. The tree in the forest exposed to atmospheric changes for centuries does not decay; and not until its supply of these fluids is cut off by felling or girdling does disintegration of fibre commence.

Disintegration may proceed from wet rot, or dry rot, both of which are caused by fermentation of the albumen of the sap.

In this connection attention should be called to the important fact, that the heart, or perfected wood contains very little fluid and very little vegetable life, and is therefore less liable to decay than the young, soft sap-wood, which is full of fluid, abounding in vegetable life and fermentable elements. A large portion of

this sap-wood, nearly thirty per cent of some kinds of lumber, which cannot be rendered fit for use by any of the "seasoning" processes, is thrown away or consumed as fire wood.

These facts should be remembered in order that the merits of "Vulcanizing" may be fully understood and appreciated, when compared with other methods of treating wood. All the processes by which the treatment of wood has been attempted are based upon the idea that the sap is not only useless, but injurious.

In "seasoning," the more fluid portion of the sap is driven out simply to get rid of it, but in the various attempts at "preserving" wood, to which reference has been made, it must be driven out, to make room for the introduction of some foreign substance intended to prevent decay. "Vulcanizing" is based upon the idea, that all the fluid matter of the wood is as useful as the fibre which is made of it, that it is necessary to the life and strength of the wood after the tree has been felled, that it contains constituents and properties essential in keeping the wood in the condition of its normal and growing state; and, therefore, it seeks *to retain and utilize the fluid matter in the wood.*

Thus the "art of vulcanizing" wood and lumber reverses the whole theory and practice of all the other processes. Howe reversed the eye of the needle, and this little change of an old method has worked a revolution in important industries, so, the simple device of keeping the fluid matter in the wood, instead of driving it out, will work a revolution in the great wood and lumber industries of the world.

"Vulcanizing" Superior to any Method of "Seasoning."

We have already noticed at some length the various methods of seasoning by the natural or open air process, and by artificial means, the time required, the loss by shrinking, cracking, warping and rotting during the treatment, the necessity of carrying large stocks of lumber, involving the outlay of capital, loss of interest, taxes, insurance, etc. Attention has also been called to the fact that the wood or lumber is only imperfectly seasoned by any of these processes, and is positively injured by others. The driving out of the fluid matter, whether by natural or artificial means, while it utterly fails to prevent swelling and shrinking, (one of the main objects of seasoning) not only diminishes the life and strength of the lumber (rendering it brittle, as in kiln-drying), but makes it porous, rough, and uneven in grain, thus creating a necessity for the further labor and expense of priming and filling. Thousands of gallons of oil are annually required in filling the pores of this *seasoned* lumber to prevent its absorbing the oil of the paint, and leaving dry pigment on the surface. To fill the pores, and smooth the rough grain of this *seasoned* lumber with sizing in order to make, by artificial means, a proper surface to receive a permanent polish or varnish finish, involves great labor and expense.

The beautiful coloring and lustre of the natural wood is often deadened and dimmed by these processes, and the lumber, especially in kiln-drying, is rendered so brittle, that in planing or sawing the fibre is broken into a fine powder which fills the air and often proves injurious to the lungs of the operatives.

"Vulcanizing," following the course taught by nature, and dictated by common sense, *retains and utilizes the sap in the wood.*

As the fluids supplied to wood in its growing state are by heat and pressure made to contribute to its life, strength and durability, so, in "Vulcanizing," the same forces are employed to make the fluids already furnished contribute to the life, strength, and durability of the wood when cut into lumber.

In nature, with the pressure of the atmosphere, only 15 pounds to the square inch, and the natural heat of the sun, much time is required for the changes in the fluids. In "Vulcanizing," with 150 or 200 pounds pressure, and with 250 or 300 degrees of heat, the results are obtained in a few hours.

By a chemical action induced by heat and pressure the fluid matter is completely changed. Its albumen and other soluble matters are coagulated and rendered insoluble, and become a woody substance, fixed in the cells and solidified with the fibre. The compound thus formed cannot be affected by the heat and moisture of the atmosphere. The wood will not therefore lose it; not losing it, the wood will not shrink; not shrinking, it will not warp and crack; and with its pores filled and fibres united, the wood will not swell from the absorption of moisture; not swelling, or shrinking, the wood will keep its shape and form, a result which has never been accomplished by any process of "sea-

soning." Moreover, in "Vulcanizing," the heat developes the resinous and oleaginous properties of the sap, which, by the aid of the pressure, are diffused through the whole structure of the wood, cementing the cells and fibres, and forming them into a homogeneous mass of great density, toughness, strength, and uniformity.

When "Vulcanized," wood or lumber is thoroughly *cured*, and is at once ready and fit for use. Its quality and condition is such that it can be employed for all mechanical purposes, for inside as well as outside work, whether plain or ornamental; it yields readily to all kinds of tools, is capable of the highest finish, and susceptible of a beautiful and lasting polish; it needs no paint or varnish, but its pores and fibres being filled and cemented with its own fluids, it is sized and primed, and will receive either paint or varnish without further preparation. From its uniform surface the plane makes a smooth, even shaving as glossy as a silk ribbon, and through its strong and closely bound fibres the saw makes a clean cut without breaking or tearing, and no injurious powder or dust is made in these operations.

"Vulcanizing" Developes, Perfects and Cures the Lumber.

"Vulcanizing" is applicable to all kinds of wood. Many of the soft, succulent, gummy woods, almost worthless even for fuel, if they could be seasoned at all by other processes, are not considered worth the pains and expense. By the curing effects of this process, they are converted into hard, firm, durable and useful lumber.

Even the young or sap-wood cut in rough slabs from the log, and generally thrown away, can by "vulcanizing" be so developed, cured and preserved as to make as good lumber for shingles and all other purposes as that made of the heart or old wood.

The sap-wood contains all the elements which compose the heart-wood, and in "vulcanizing," these elements are, by heat and pressure, utilized in the sap-wood as they were by nature in forming the heart-wood.

Lumber is often filled with knots from which the regular fibre of wood will, by any "seasoning" process, shrink, and draw away, causing them to drop out, and thus render the lumber almost useless except for ordinary fencing. If, however, the knots should remain in their places the exudation of juices to which they are

subject, ruins the effect of paint, varnish and polish, unless they are treated by an elaborate and expensive process known as "knotting." In all cases the knots must be "killed" before any "seasoned" lumber is used.

This is done by cutting away the knots to a certain depth, and then filling over them with putty or a like substance. Sometimes the knots are covered with gold or silver leaf, or with a kind of "knot sizing."

In "vulcanized" lumber there is nó necessity for any such work. The wood does not shrink away from the knots, and the knots themselves are *cured*. Their juices, like those of the surrounding wood, are coagulated, solidified, and fixed, or set. They not only do not lose their fluids by exudation, but are retained and held firm in their places, and become homogeneous with and a permanent part of the lumber, giving variations of texture and coloring to the wood which add greatly to its beauty.

"Vulcanizing" renders Woods of all kinds more beautiful.

The difference in the grain and color of wood is due to the manner in which the cells and fibres combine in growth, and the kind and quality of fluid matter de-deposited in them. The more matured and solidified sap imparts the darker colors, as seen in the old or heart-woods.

"Vulcanizing," by developing the resinous, oleaginous and other properties of the sap, and by diffusing and solidifying them in and through the cells and fibres, brings out the grain of the wood in the richest and most beautiful colors. The masses of fibre, and intervening veins in the circles of growth, crossed by the medullary rays of flattened cells, with every peculiarity of formation and combination, are distinctly marked by the various shades and tints of coloring imparted by the fluid matter. When "vulcanized" wood has passed through the hands of the skillful finisher and polisher, these beauties are developed and exhibited with striking effect. The deep red and yellow of the hard parts of the wood and the delicate white of the soft parts show through the polish in beautiful contrast. The veins of light yellow look like streaks of pure amber, or layers of gold. The commonest and cheapest woods are so much improved in appearance by "Vulcanizing" that they may be used for decorative purposes.

The ordinary "hemlock," when "vulcanized," is more beautiful than the imported and expensive "white ash."

The effect of this process upon "pitch pine," one of the cheapest woods in the market, is truly remarkable. In that of regular growth, the hard wood is made to look like fine old mahogany. In that of irregular growth, the old wood is brought out in clumps of various forms, in dark, rich colors, encircled and shaded with the more delicate tints of the younger formations, all embellished and illumined by the golden hues and silver rays of veins in numberless irregular waves, and when mirrored forth in the bright and lasting polish, of which it is susceptible, it presents a mottled, dappled appearance, more exquisite than that of the most rare and precious woods. Even the rare and precious woods imported at great expense cannot take useful form, and beautiful appearance, by any "seasoning" process, without careful keeping for many years. By "Vulcanizing" they are, in a few hours, given a density of fibre, uniformity and smoothness of grain and surface which fits them for use at once, and their beautiful coloring matter is brought out in a fulness and richness which only great age could develop.

Green mahogany, when "vulcanized," looks like mahogany thirty years old.

"Vulcanizing" Preserves wood from Decay.

It will not be difficult to show the efficiency and value of the "vulcanizing process" in preserving wood and lumber from decay.

We have seen that wood in its growing state is furnished with the elements of life, strength, and preservation by its continued supply of the natural fluids; that when cut down, it is liable to decay, which always commences in the fluid matter which it contains. Decay, whether in the form of what is called wet rot, or dry rot, is caused by fermentation Fermentation, in all vegetable substances, results from exposure to the influences of heat, and moisture, alternations of wet, and dry, or continued moisture with heat. Fermentation is defined to be "a state of vegetable matter, the component parts of which have acquired sufficient force to produce an intestinal motion, by which the oleaginous, saccharine, gummy, and albumenous particles exert their several peculiar attractive and repulsive powers, forming new combinations which at first change, and at length altogether destroy the texture of the substance they formerly composed."

This condition of timber, when aided by heat and fungi, is followed by complete decomposition in which all trace of organization is lost, and only dry dust remains. Experience has shown that this fermentation, this change, this alteration and new combination in wood can

be prevented by the coagulation of the albumen of the sap. Hence the claim for all the preservative processes now in use, is *the prevention of fermentation, by the coagulation of albumen*. And this is done after the displacement of sap from the pores by the introduction of some foreign substance. It is a well known scientific fact that 170° of heat will coagulate the albumen of the sap. The 250° or 300° of heat employed in "Vulcanizing" will thoroughly accomplish that important result. In some of the processes the coagulation of the albumen is effected by the use of a substance antiseptic in its nature, such as creosote, pyroligneous acid, tannin, and hydro-carbon oils.

It so happens that all these are contained in the natural fluids of wood, and may be obtained by its distillation, so, that, when preparing the wood for the introduction of these substances, by depleting its pores to make room for them, there is a loss of precisely the same antiseptic properties as those sought to be injected by artificial means.

In "Vulcanizing," the natural fluids are kept in the wood, and the great heat employed not only coagulates the albumen, but developes in the fluids the oils which contain the antiseptic properties, such as creosote, pyroligneous acid, etc., while the great pressure prevents their escape and causes them to be distilled in and through the cells and fibres of the wood, and to condense and solidify with them.

Superiority was claimed for the "creosoting" process over all the others in use, because it not only coagulates the albumen, but, by filling the pores of the wood with oil, prevents the absorption of moisture.

"Vulcanizing" *not only coagulates the albumen,* but *fills the pores of the wood* with an insoluble compound made up of the albumen and certain resinous and oleaginous substances of the sap, *which also prevents the absorption of moisture.*

Thus "Vulcanizing" in preserving wood, as in preparing and beautifying it for all its purposes, deals with and makes use of the natural fluids which it contains.

It should be borne in mind that in "creosoting," "Burnettizing," "Kyanizing," etc., coagulation of albumen, and thereby preservation from decay, can only be effected by a foreign substance introduced into the wood. This can be done in sap-wood and certain kinds of woods, by drawing or driving out a portion of the fluids, and pressing the preservative substance into the empty pores. But in heart wood of many kinds, and in both sap and heart of some kinds of woods, the fluids are so solidified that they cannot be drawn out, nor can the foreign substances be forced in. *There is, therefore, a vast amount of wood and lumber, which cannot be preserved from decay by any such processes.* The simple, natural, common sense process of "Vulcanizing" is applicable to both sap and heart of all kinds of woods. It utilizes the substances already in them. The heat which it employs will penetrate all kinds of wood, coagulate the albumen, and develope the antiseptic properties wherever sap in any form may be found. The sap-wood full of its vegetable juices, and the heart-wood, however matured and compact, are alike susceptible of the treatment, are alike preserved by its effect.

Scientists have said that when the tree has been separated from its roots, the sap contains the principle of vegetation, which, by certain influences of the atmos-

phere, is brought into activity, causing dry rot, and other species of decay.

In "Vulcanizing" *the vegetation, or living principle of the sap is arrested and destroyed by the great heat to which it is subjected.*

This effect of heat is illustrated and proved beyond the necessity for further experiment or argument by the results of what is called the "charring process."

The "Charring Process."

An experience of ages has shown, beyond all question, that the "charring" of wood will preserve it from decay. By this process, used by the Venetians for a long time, especially for piles, wood has been made to last for centuries.

After the Temple of Diana at Ephesus was destroyed it was found to have been built on charred piles. At Herculaneum, after 2,000 years, charred wood was found whole and undiminished. In the Leverian Museum there was a post, said to have been dug out of Fleet Ditch, charred at the lower end, with the name of Julius Cæsar cut in it. From time immemorial, particularly in France, it has been the practice to char the ends of poles driven into the ground, and charred wood has in many countries been employed as land marks.

Mr. James Randall, an English architect, says "charring," only, can be relied on in all cases as an effectual protection against dry rot."

The "Revue Horticole" states, that "charring" has been proved to be the best mode of prolonging the duration of wood.

Many sleepers on Belgian railways are charred, the engineers preferring this process.

"Charring" is but a crude and imperfect mode of "vulcanizing."

As a preserving process "charring" is based upon the only correct principle, *that of utilizing the natural fluids*

of the wood by coagulating, solidifying, fixing them in the wood so as to preclude fermentation or chemical change, thus rendering the wood harder, denser, tougher and stronger, while at the same time preserving it from decay. To do this, heat alone is employed. But in "charring" it is difficult to cause the heat to penetrate to the centre of timber without burning too deeply, and injuring the whole structure. Hence charred fence posts, after many years, are all perfectly sound as far as the heat has penetrated, but some may be found rotten in the centre.

Then again, in "charring," while some of the fluids may not be reached, others necessarily escape from the wood and are lost in the operation.

But, in "Vulcanizing," the heat is made to penetrate through and through to the very centre, and the fluids are so held, confined by pressure, that none of them can escape the action of the heat.

The "charring" process, which has been tested by the world for centuries, had proved before the art of "vulcanizing" was discovered, that the coagulation of albumen, and prevention of fermentation and decay in wood *could be accomplished by heat.*

Changes effected through Heat.

These, to some extent, are simply but strikingly illustrated in the household chemistry of every day life.

Heat is employed to prevent and arrest fermentation in all the preserved fruits and confections of the pantry. Its power of coagulation and of producing changes in substances is fully shown by its remarkable effect upon the albuminous matters of the egg when cooked in the kitchen. In every 100 parts of the egg composed of white and yolk there are 71 and three-fourths parts water, 14 albumen, 13 fat, etc., and 1 and one-fourth phosphates, etc. When these albuminous liquids, with their large percentage of water, are subjected to 212° of heat, they become solidified by coagulation. This solidified substance, thus produced by heat, contains in 100 parts, 49 and a half of albumen, 46 of fat, etc., and 4 and a half phosphates, etc., *but no water.*

In their natural state, the fluids of the egg, although composed so largely of water, could readily be dissolved with water, but when coagulated by heat they become insoluble. Their 14 per cent of albumen is converted into 49 and a half per cent., their 13 per cent. of fat, etc., into 46 per cent., and their 1 and one-fourth per cent. of phosphates, etc., into 4 and a half per cent., while their 71 and three-fourths per cent. of water is gone.

How wonderful the change of the soluble into the insoluble! The watery liquid white of an egg is converted

into a solid, having the chemical properties of fibrine, a result which, although seen every day, has never been explained.

Heat plays an important part in reference to chemical force by which bodies are united and disunited. It increases the affinities of substances for each other. In the case of the coagulation of the egg fluids, more than half of the water combines with the albumen, little less than half with the fat, etc., and the balance with the phosphates, etc.

It is also a remarkable fact that water, under a pressure sufficient to prevent its escape in steam, may be so highly heated in liquid state, that it will decompose natural fat, and as an organic base form a perfect and fixed combination with certain fatty elements. This combination of water with the elements of fat, really *the mixing of oil and water*, seems more singular than the combination of water with the albumen of the egg.

In the metamorphoses of the soluble albumen into the insoluble, during the process of incubation of the egg, heat performs an important part.

The temperature to which the egg of the hen is submitted, at intervals, for a period of three weeks, is about 104°. Under this influence the albumen of the white of the egg, which is entirely soluble in cold water, is in 21 days converted into a fully developed chicken, which feeds upon the yolk. The soluble albumen assumes the insoluble condition in the form of bone, beak, feathers, claws, etc. The same result can be produced by artificial heat, and in some kinds of eggs by the heat of the sun, *but there can be no organization without cohesion, and no cohesion without atmospheric pressure.* So that, when, in incubation, the soluble albumen is not only converted into the insoluble, but

also into fibrine, as seen in the muscular fibre, and into gelatinous tissues, as it exists in the bone of the chicken, heat (whether animal, artifical, or of the sun) and pressure are both employed.

Just so the soluble is converted into the insoluble, when, through the agency of heat and pressure, cellulose and lignine, compounds formed of carbon united with oxygen and hydrogen, (the elements of water) are organized into the young wood of the growing tree. And so, also, is the soluble converted into the insoluble, when the albuminous, glutinous, resinous and oleaginous compounds of the fluid matter found in wood and lumber are sujected to heat and pressure as in "vulcanizing."

The pitchy substances of pine wood liable to fermentation and decomposition in their natural state are, by heat, converted into rosin which will not rot.

The ordinary pitch pine, with which many of our Southern States abound, although a very durable wood, is liable to rapid decay in contact with lime, and in confined, warm and damp situations: but, when "vulcanized," heat not only coagulates the albumen of its sap, but converts its pitchy juices into an oil, which by pressure is diffused through the wood. By the oxidation of this oil, all the pores become filled with rosin, which, being in no manner affected by atmospheric heat and moisture, remains permanently in the wood preventing it from swelling and shrinking. The wood, thus filled with a material having in it the elements of varnish, is not only perfectly beautiful in grain and color, but is susceptible of a polish far more brilliant and lasting than any coat which can be given with a brush. "Vulcanized pitch pine" is as hard and as

strong as oak; it rivals the precious woods in beauty of appearance, is a practical non-conductor of electricity and of heat, resists the ravages of the " Teredo Navalis," and of the "comejen," or (wood louse), and the ants of Panama and other tropical countries, *and it will not rot.*

Important Results from Chemical Change.

Until recently, according to the "London Times," the annual production of steel in Great Britain was not over 50,000 tons, and at a cost of $300 per ton. By an ingenious method of applying heat, discovered by Sir Henry Bessemer, a change is now effected in pig iron whereby a million tons or more of steel can be produced every year at a cost so reduced that steel can be substituted for iron for many important purposes, and millions of money be saved. The Bessemer Process, which has already earned for its inventor not only fame, but also a princely fortune, is simply a method of "vulcanizing" which greatly improves the quality of the iron.

"Camphor," a vegetable product from the sap of wood, is by heat so entirely changed in its nature, that it enters largely into the production of "celluloid," a material of extraordinary and valuable qualities, now rapidly taking the place of ivory and other expensive substances in many of the arts and industries of the country. Another use is thus found for a process of "vulcanizing."

"Caoutchouc," or gum elastic, a product from the milky juices of tropical woods, for a long time useful only in erasing pencil marks, under the influence of heat, as employed in the art of "vulcanizing," combines in some inexplicable manner with a small por-

tion of sulphur, and forms what is known as "vulcanized rubber," a substance more elastic and less soluble than gum, which does not melt even at the boiling point of mercury, or become stiff in the cold, and which differs not only in color, but in all its essential properties from the original gum. Thus an almost useless gum, by a slight chemical change, becomes a useful material so important in the industrial arts, that thousands of persons find employment in applying it to numberless purposes, and millions of dollars are annually realized from its production.

The art of "vulcanizing" to whatever substances applied deals in a philosophical way with their chemical constituents and natural elements, changing the relation of particles which in one case may produce density, in another elasticity, strength and durability, and in some change of color. All these effects are produced, when the "Vulcanizing Process" is applied to wood, because of the peculiar elements and properties found in its fluids. The wood is developed in strength and beauty, is thoroughly cured, primed, filled, knotted and prepared for use, and at the same time preserved from decay, by a chemical change produced in its fluid matter.

The discovery of new elements in nature, and of new forces in chemistry or physics, whereby the same can be utilized, is the grandest achievement, the highest creation within the reach of human power.

Bessemer, Goodyear and others, by their discoveries and the utilization of them in the treatment of iron and vegetable substances, have fully illustrated and exemplified the remarkable effects produced, but give only a faint conception of the wonderful results achieved by the "Art of Vulcanizing Wood." The preservation of wood from decay alone will benefit the world more

than the combined products of all their great inventions.

"Celluloid," and "Rubber" were entirely new substances for which uses had to be discovered, and the scope and power of inventive genius have never been more clearly shown than in the 3000 patented applications of "Vulcanized Rubber."

The uses of wood and lumber in their crude and unsatisfactory form, already so great that inventive genius is taxed to find the means of doing without them, will only be increased, when, by "vulcanizing," they are thoroughly cured and prepared, and rendered more valuable for all purposes.

The demand for "Vulcanized" Wood and Lumber.

According to the census of 1870 there were in the United States 63,938 establishments manufacturing articles made entirely of wood, employing 393.387 persons, and using material worth $309,921,403 annually. There were 109,512 industries, such as carriage and furniture making, ship building, etc., employing 700,915 persons, and using material worth $488,530,844 annually. These incomplete estimates fall far short of embracing the whole amount of wood and lumber used in this country, but they may give some conception of the billions upon billions of feet required by these 174,450 establishments to give employment to 1,094,302 persons. When we consider, that all this wood and lumber must go through some sort of "seasoning," much of it requiring from two to five years, and some a longer time, and that large stocks must be carried to keep up the supply, we may form some idea of the great loss of time, money and material which is thereby incurred.

By "vulcanizing" wood and lumber can, in a few hours, and at a cost of from 50 cents to $1 per thousand feet, be thoroughly cured and prepared for use, thus saving the loss of interest, taxes, insurance, etc., and the loss by shrinking, cracking, and warping of the material, consequent upon the tedious operation of "seasoning." Besides, "vulcanized" wood or lumber is not liable to swell and shrink; it is primed, filled,

knotted, and preserved from decay; it is tougher, stronger and more beautiful, and in every way and for all purposes superior to any "seasoned" wood or lumber.

The vast amount of wood and lumber needed at this day could not be supplied with the old upright saw, nor could it be shaped, formed and fitted, as now required, with the hand plane, chisel, and mallet. These implements are too slow. They are behind the age, and of necessity have been superseded by late inventions which do the work more rapidly. The processes of "seasoning" are too slow. They, also, are behind the age, and must of necessity be superseded by a late invention, which will put wood and lumber into better condition for use, and in a much shorter time.

The inventions of *gang-saws, of planing, tongueing and grooving, and shingle machines* are saving millions every year in the supply and working of wood and lumber, but the advantages of all of them combined will be more than realized from the discovery of the art of "vulcanizing wood." We will call attention to some uses and a few branches of business in which this art will prove of the greatest benefit.

For all Railroad Purposes, Vulcanized Wood and Lumber needed.

In the number and extent of our railways we surpass every nation upon earth. Our greatest achievements in railroad building were made when money was abundant, business active, and our whole people moved with a spirit of progress and speculation. All the contracts then made contained specifications requiring rapid work in making road-bed, in the laying of ties, and in the spiking down of rails. Permanence of structure, durability of material, and economy in expenditure were lost sight of in the effort to put bonds and stocks, and the road itself upon the rising market in the shortest possible time.

The attention of railway managers and builders was mainly given to constructing, perfecting and embellishing the rolling stock, and every improvement looking to such increase of speed, and such adornment and comfort of the cars as would invite the greatest public patronage was readily adopted.

The strength and durability of the ties and rails seemed to be unworthy of consideration. Within a few years only, and under the pressure of hard times, has the steel rail been adopted from a necessity for economy. But there can be no wisdom in running expensive cars and laying steel rails over ever decaying and ever changing ties. No rolling stock or rails can be successfully operated *without a solid road-bed,* and a *solid road-bed* cannot be secured without a sufficient number of sound, substantial sleepers.

Common sense should teach us to look first to the grading, next to the ties, then to the rails, and finally to the rolling stock, thus building from the bottom up, instead of from the top down.

The railroads of this country have cost $4,568,591,935. Even with our increased and increasing population and manufactures, with our vast mineral resources and wonderful agricultural products, it becomes a serious question whether the investment of such an enormous sum of money can be made to pay. It certainly cannot without economy in the expenses of running and repairing the roads.

We have now 94,000,000 miles of railroad requiring in their construction 253,800,000 ties, the average life of which is about five years. One-fifth of the whole number, being 50,760,000, must therefore be annually replaced with new ties at a cost (including labor) of one dollar each. Thus, to repair the damage to ties from wear and tear, and from decay, our railway companies incur an annual expense of $50,760,000.

This is a large sum of money, which if saved, instead of lost each year would greatly increase confidence in railroad investments. It can be saved by the use of "vulcanized" ties, which are preserved from decay and are so dense, hard and tough that they will not split, and will for a long time resist the wear and tear from the friction of the rails.

The mere cost of replacing the old ties with new ones does not cover the loss incurred by railroads from defective ties. The disturbance of the road-bed attending the removal of a tie works serious injury to the rolling stock. Split, worn and rotten ties also cause an oscillating motion of the cars which sometimes throws

them from the track, or occasions a sudden and unequal pressure, by which the rails are broken. The uneven surface presented by a rotten tie, or a disturbed road-bed, produces increased friction, and an undue strain upon the axles and flanges of the wheels, which often result in disaster, and when a process has been found by which ties can be preserved from decay, and much injury to rolling stock, and many accidents be prevented, it would seem to be the duty of railroad directors to adopt such a discovery, especially when the public safety demands it.

Its adoption moreover is dictated by good business sense, as a measure of practical economy and prudent foresight.

To supply the 94,000 miles of completed railroads with 253,800,000 sleepers, cut from selected trees of a size sufficient to make only one or two, has destroyed the choice young growing timber of thousands upon thousands of acres of the finest woodlands along their lines. The requirement of 50,000,000 of ties, for repairs, will consume annually thirty years growth on near 100,000 acres of the best woodland.

With this constant and exhausting drain upon the forests, so rapidly disappearing from other causes, sleepers must become scarcer and dearer year after year, until at no distant day it will become a question of serious moment where the ties needed for our railroads can be obtained at any price.

Years ago this question was forced upon England and other European countries by the great and increasing scarcity of timber, and the result was the adoption of methods of preserving sleepers from decay. It was shown by practical tests that such timber *could* be pre-

served by the "Burnettizing," "Kyanizing," "creosoting," and other processes,

The "creosoting" process, first employed in 1838, has grown rapidly in favor with experience, until at the present day it is in use on nearly all the railroads of Europe, and is recommended by the most eminent engineers.

"Creosoted" sleepers of Baltic, American, and Scotch fir, and of other kinds of wood were laid upon the "Stockton & Darlington," the "Lanchasire & York shire," the "Midland & Great Western" of Ireland, the "London & North Western," the "Dublin & Drogheda," the "Great Eastern," the "Dutch Rhinish," and upon the "Bristol & Exeter," in 1838, 1840, 1842, 1844, and 1846, and we have the testimony of such eminent engineers and superintendents as Badge, Price, Hartly, Woodhouse, Dyer, Dawson, Freem, and Summerson, that they are perfectly sound and free from decay,

At a meeting of the "Institute of Civil Engineers," London, Mr. Brunel has expressed the opinion that "Creosoted" timber would last 40 years; that "Creosoted" sleepers would out last sleepers of iron, and Mr. Hawkshaw said, he had never known an instance of decay in creosoted ties even in the most unfavorable positions. We have the testimony of the "Building News" that, creosoted sleepers of American fir, placed on the line from Manchester to Crewe in 1838, are still as sound as when first laid.

"Creosoting" preserves sleepers from decay by the coagulation of the albumen of the sap. To do this the oil of Tar is forced into the timber. The oil is expensive, its introduction difficult, the machinery employed com-

plicated, the process elaborate, and tedious, and applicable only to sap wood, or soft, sappy kinds of woods.

The cost of "creosoting" is from 35 to 40 cents per tie.

"Vulcanizing" also, *preserves sleepers from decay by the coagulation of the albumen of the sap. To do this the timber is subjected for a few hours to great heat and pressure. The machinery is simple, the process rapid and effectual, and is applicable to both sap and heart and woods of all kinds.*

Cost of "Vulcanizing" only one or two cents per tie.

Regardless of the expense of treatment, the railway managers of Europe are not so unwise as to put steel rails upon perishable sleepers. When the cheapness and durability of "vulcanized sleepers" is understood, the railway managers of America will not be so unwise as to put steel, or even iron rails, upon any except preserved sleepers.

There are in this country about 150,000 miles of railway fences, and the annual expense of repairing them amounts to from $12,000,000 to $15,000,000. This is another large sum of money which can be saved by the use of "vulcanized" wood and lumber.

It is estimated that the value of the wood and lumber employed by the railways of the United States in the erection of passenger and freight stations, platforms and buildings is $77,692,000; of engine, car, and store houses $17,922,214, and of bridges $85,634,288.

We have no means of arriving at the annual cost of repairs occasioned by the rotting which takes place in this vast amount of untreated wood and lumber, but it must necessarily reach an enormous sum.

Again, there were in the United States in 1879, 12,009 passenger cars, 4519 baggage, mail and express cars

and 480,190 freight cars, and the value of the wood and lumber employed in their construction is estimated at $135,620,960.

The rotting of car wood-work, (especially of freight cars, always exposed to the weather) necessitates an annual expenditure of nearly $16,000,000.

Even the sleeping and drawing-room cars, which are so beautiful in design, of such exquisite finish, and which contribute so much to our pleasure and comfort, are built of wood liable to decay, and they need repairing after running only three years and a half.

In 1878 there were over fifty of these elegant cars overhauled at one establishment. They presented a perfectly sound appearance, but when the well-painted, varnished and gilded outside covering was removed, there was a rottenness of sills and uprights, between the inner and outer casements, which would have appalled the most experienced railroad traveler.

Why incur this expense and trouble of repairs, when by "vulcanizing" the rotting of all wood and lumber can be so easily prevented?

If it were generally known that by "vulcanizing," wood and lumber could, in a few hours, at $1 pr. thousand, and not over two cents pr. tie, be developed in toughness, strength and beauty thoroughly cured and prepared for use, and at the same time be preserved from decay, the stockholders of all our railways would to-day, by a unanimous vote, declare, that, hereafter in building and repairing cars, fences, station houses, depot buildings, and platforms, bridges, etc., no timber, no wood or lumber, no ties should be used without being "vulcanized."

Vulcanized Wood and Lumber the most suitable for buildings.

It is said that there are in this country 30,000,000 of people living in houses made chiefly of wood. In 1870, there were in the United States 2,659,985 farms on which dwellings, stables, barns, and other out-buildings are for the most part built entirely of wood. The census of 1870 places the number of dwellings in the whole country at 7,042,833, and wood and lumber enter largely into the construction of all not built entirely of that material. The same is true of the many public buildings, churches, educational and charitable institutions, stores, manufactories, warehouses, etc., not enumerated in the census. All the wood and lumber employed in these buildings, is liable to destruction from either dry-rot, or wet-rot, by which not only the materials perish, but the labor expended in fashioning and fitting is lost. Joists enclosed between floors and plastered ceilings, in the juncture of different woods put end to end, over and under cellars, or fitted into new walls, are all liable to decay. Bond timbers, wall plates, ends of girders, joists and lintels frequently rot from contact with lime and damp brick work. In every situation admitting moisture untreated wood will rot. In stables, wash houses, etc., even where air circulates freely, a warm moist atmosphere is an active cause of decay.

In warm cellars, and in all confined situations where the air is filled with vapor, without a current to change it, dry-rot proceeds with wonderful rapidity. The germs of fungi, producing dry-rot, are easily carried in all directions through a building in which this evil makes its appearance, and before it has time to destroy the principal timbers, germs penetrate behind the skirtings, dadoes, wainscotings, and mouldings, drawing in the edges of the boards, and causing them to split horizontally and vertically. The floors of kitchens and basements, floors beneath parquet work, or covered with painted oil cloth, or Kamptullicon, and all coverings of shingles or boards rot very rapidily.

In roofs ceiled below and slated above nearly all the timbers have been known to be destroyed by dry-rot in a few months.

No reliable estimate can be made of the loss incurred by the constant decay of wood in buildings, and no basis for even an approximation of the amount could be obtained, except from the testimony of the 500,000 carpenters engaged in building and repairing the houses of this country.

Exposure to rain, contact with the ground, or the influnce of warm, damp, stagnant air in confined situations will produce fermentation and decay in wood and lumber however well it may have been "seasoned." Under conditions and in situations favorable to decay, the decomposition of the best "seasoned" wood will only be delayed until there has been time for the absorption of a sufficient amount of moisture.

Protection against the destruction of the wood work of buildings is sought in the use of oil and paint, but they cannot be relied upon. Very often, while going through the process of "seasoning," the germinative

principle of the vegetable juices of wood and lumber will be brought into activity which is not discoverable by any external manifestation, and in spite of oil and paint, this incipient decay will progress until complete destruction of the material is accomplished. Very often the coatings of paint cut off all chance of exhalation, and deprive the wood of the beneficial influences of contact with the air, while moisture, with its insidious and baleful results, is allowed to pass through without interruption.

The destruction of the sills and sashes of windows, under frequent renewals of paint, shows the almost irresistible power of heat and moisture in producing vegetable putrefaction and decay in wood.

Another great injury to which buildings are liable is occasioned by the swelling and shrinking, the cracking and warping of wood-work. In the heating of houses by furnaces or otherwise, the doors, sashes, and shutters shrink from their facings and fastenings. Panels recede from the grooves into which they are fitted exposing on each side wood never touched with paint or varnish. The beautiful effect of expensive ornamental figures and carvings in wood employed in decoration is often destroyed by the warping and cracking consequent upon shrinkage. The shrinking of joists and laths frequently occasions the falling of plaster from ceilings which is always attended with expense, trouble and inconvenience, and danger to life. In shrunken floors, wainscotings, mouldings, architraves, etc., are presented unsightly openings which furnish harbors for dirt and vermin, for moisture and fungi. This change of shape and form will take place in the best wood and lumber however well "seasoned," and neither oil, paint, nor varnish will prevent it.

Against this incalculable loss by rotting and wide spread damage from swelling and shrinking, the only security is to be found in the use of "Vulcanized" wood and lumber.

Any kind of wood-work, whether plain or ornamental, of "Vulcanized" material, will stand in all situations, and under all conditions. The juices of wood and lumber are by "vulcanizing," thoroughly *cured*, their germinative principle is destroyed, and exposure to heat and moisture, however prolonged, will not produce in them vegetation, fermentation, putrefaction, or decay "Vulcanized" wood or lumber is *preserved* and needs no protection from paint and oil. It is also primed, filled, knotted and at once made ready and fit for all uses and purposes, and is not only better in all respects than "seasoned" wood or lumber, but far cheaper; and while meeting all the practical requirements for economical and substantial building, it has other merits which entitle it at the present day to precedence over all other kinds of wood or lumber.

Of the many and important improvements in the practical arts, which have distinguished the last twenty-five years of progress, the most noticeable are to be found in architectural structures. The skill and genius of the architect, employed hitherto with such marked effect upon the *exterior* construction of the dwellings and public buildings that our great metropolis is made to appear in the eyes of foreigners like a city of palaces, have lately been directed to the *interior* finish and decoration.

Special attention is now given to the wood-work of fine houses, and by architectural ingenuity and refined taste woods of various kinds are combined in styles of

finish and ornamentation of exquisite beauty and elegance, and their use in all interior fittings and decorations has become a ruling fashion. We enter the modern city residence through a door of richly colored, substantial wood, highly ornamented and polished. We find the halls wainscoted throughout with wood; we find marquetry floors of curiously grained woods of an infinite variety of patterns, Elizabethan staircases with panels, rails and posts of elegant kinds of wood, open fireplaces supplied with beautifully wrought mantelpieces of wood, surmounted with statues carved in wood, and supporting elaborate cornices of wood; and chambers finished in different kinds of light or dark colored wood.

In the ornamentation, embellishment and finish of the interior, the woods are employed in such manner as to display with the greatest effect their natural beauties utterly ignoring the old, absurd custom of disguising them with paint. To give greater distinction to the decorative art, and gratify tastes grown extravagant with prosperity, imported woods of rare and expensive kinds are extensively used.

This fashionable style of natural wood finish is being adopted also in building houses intended for offices and other business purposes, and by combining economy with beauty and elegance it becomes a valuable improvement. Very often in growing cities the remodelling of the interior structure of buildings becomes necessary, and it is of great importance that alterations and adaptations to any desired arrangement should be made with facility and without marring the beauty, or affecting the durability of the building, which cannot be done when its walls and ceilings have been covered with plaster.

It will not be long before this fashionable and sensible wood finish style will find its way into the suburban and village residences, and into the millions of farm houses.

What a field is thus opened for the wonderful "art of vulcanizing wood and lumber!" An art by which, at little expense, and in a few hours, the rare and precious woods can be wonderfully improved in quality and appearance, the cheapest and commonest woods be made beautiful enough for decorative purposes, and all kinds be thoroughly *cured* and *prepared for use*, and so increased in density, firmness and uniformity of structure, that their natural beauties of grain and color can be brought out by finish and polish with the most pleasing effect.

There are 120 different species of trees which grow in this country to a height of over 50 feet. From the remarkable effect of "vulcanizing" upon pitch pine, white pine, spruce, hemlock, poplar, walnut, hickory, oak, beech, birch, bast, cherry, and even upon sycamore, cotton wood and gum, we have reason to believe that many other kinds of our native woods will be developed by this art, until we shall have building material for useful and ornamental purposes in such infinite variety, that in all interior finishing lights and shades can be blended, and colors combined in harmony to suit the most delicate taste and gratify the livelist fancy.

NOTE. "In the Imperial Palace at Berlin one or two of the Emperor's private rooms are fitted up with pine; the doors, windows, shutters and everything else of fir wood; these are cheap woods but of great natural beauty when polished.

NOTE. "The offices of Herr Krauss (Architect to the Prince and Princess Louis of Hesse) who resides in Mayence, are fitted, or rather the walls and ceilings are lined with pitch pine wood, parts of which are carved, and the whole French polished, and the effect is very fine."

NOTE. "The reception room, where the Emperor of Germany usually transacts business with his ministers, and receives deputations, etc., as well as the adjoining cabinets, are fitted with pine, not grained and painted, but well French polished."

NOTE. "The polished pine composing the interior wood-work in the house of the late Sir Anthony Carlisle, in Langham Place, London, is very like satin wood."

[From the "News."]

BEAUTIFUL WOODS IN ARCHITECTURE.

Since the days of Solomon, when "temples" and "dwellings" of "hewn stone" were finished with firs and cedars from the forests of Lebanon, there has never been such an extensive use of timber in the embellishment and adornment of altars and firesides as at the present time. The interiors of churches, public buildings and private residences are now finished with natural woods in every style of beauty and elegance known to the decorative art.

To satisfy the extravagant tastes of this extravagant age, rare and expensive imported woods, such as are known in commerce as "precious woods," are so largely employed for these purposes, that the demand for them in this and other countries has become simply enormous. When we consider that these high priced woods can be found only within a tropical belt of very limited area, and the extent to which they are used not only in fitting and finishing the houses of all countries, but also the steamers and steamboats of the oceans, lakes and rivers, as well as the railroad cars, musical instruments, etc., we can easily forecast a time when the supply will not be equal to the demand.

This emergency has already been anticipated and provided for by the ingenuity of an American inventor, who has discovered a method of "vulcanizing" wood and lumber, whereby the commonest and cheapest of our native woods can be made as beautiful and elegant in appearance, as susceptible to high finish and ornamentation, and as useful and effective for all architectural and decorative purposes as the finest imported woods.

We have seen specimens of ordinary "pitch pine" which, after receiving this treatment, were as handsome in rich and variegated colors

as the most costly South American woods, and also specimens of "vulcanized" white pine and spruce which presented the soft, lustrous appearance of the finest satin wood. It is said that "vulcanizing" gives solidity, toughness, strength and durability to wood, and also preserves it from decay. It certainly makes a wonderful improvement in the grain, coloring, and appearance of all kinds of wood, and the discovery of the art is a great triumph for America.

Conservatories.

All wood used in the construction and internal fittings and arrangements of conservatories is liable to very rapid decay. The heat and moisture, necessary to the germination of the seed and the progress of vegetation in the production of the branches, leaves and flowers of the plants, is constantly supplied to such houses by artificial means.

The pores of green wood or lumber are filled with juices which, in their natural state, contain the power of vegetation, the principle of life, which is not extinguished by the process of "seasoning," but remains in a dormant, quiescent condition so long as the wood or lumber is kept perfectly dry. Under the influence of moisture, however, when aided by heat, this power of vegetation is brought into exercise; this "Vis Vitæ" is brought into activity, producing intestinal motion, fermentation, and decomposition of the wood. Thus the same amount of heat and moisture necessary to the rapid propagation and growth of plants will produce the germinative life, or vegetation in the juices of wood necessary to its rapid fermentation and decomposition.

In the process of "vulcanizing" this power of vegetation found in the wood is destroyed by the great heat employed, just as the vitality of seed is destroyed by baking.

In greenhouses employed in the propagation of exotic plants, the stagnant air is so filled with moisture, and kept at such a temperature that all wood-work within its reach is subjected to an absorbing power of 100 degrees. Any kind of wood, in its natural state, however carefully seasoned or painted, when placed in such an atmosphere, will become thoroughly saturated with moisture and remain in that condition until it is destroyed by fermentation and decay.

A short time ago the thought occurred to a scientific gentleman, who had faith in this process, of placing some pieces of "vulcanized wood" in a house of this kind in order to see how they would be affected by the heat and moisture.

It would seem enough to expect of wood, which has received a treatment of only a few hours, that it prove quite as good as wood which has had the benefit of years of preparation, but it was now proposed to subject "vulcanized wood" to a test which no other kinds of woods had ever been known to stand.

Nevertheless, the specimens were furnished, and the results of the experiment are fully set forth in the following note to the gentleman at whose instance it was made:

DEAR DR——:

I have now fully tested the six pieces of "vulcanized" woods, which you brought me, to ascertain what effect heat and moisture, and dry heat would have upon them.

I first placed them in a room with orchids and other tropical plants, and at a point where they would come in contact with the greatest amount of heat and moisture, the temperature of the room ranging from 100° to 130° Fht. The samples thus exposed to an absorbing power of over 100°, for 96 hours did not take up any moisture.

All other woods, of various kinds, which in my whole experience I have seen exposed to the heat and moisture, and stagnant air of such

propagating rooms, have readily absorbed moisture, and become saturated with it in 48 hours, and in all cases the result has been fermentation and rapid decay.

I afterwards placed the six pieces of wood in the furnace room, where there is a great heat, and no moisture whatever, where they remained four days and four nights without any perceptible change.

For about 24 hours or more the pieces were so close to the furnace, and the heat so great, that I had to remove them to prevent ignition.

From the severe tests made with these "vulcanized" woods, I am satisfied that they are not only perfectly seasoned, but preserved from rot.

For the purpose of identification, I have put my name upon each of the pieces of wood tested as above by me.

F. GOLDRING,
Botanist and gardener to
E. CORNING, Esq.

Albany, New York.

Summer Resorts and Watering Places.

There are now in the vicinity of the cities of this country, especially of New York, a large number of summer resorts and watering places. Through these, aided by rapid transit facilities, a great change has been effected in all kinds of business. Its suspension during certain months is not so general as it was a few years ago. Dealers from all parts of the country now congregate in cities accommodated with these places of resort, and instead of spending the warm months in idleness, attend to business during the day, and enjoy the calm repose and pure air of the country, or the delightful breezes of the sea at night.

Nearly all the improvements of these summer establishments are constructed of wood, and should be of "vulcanized" wood. When we consider the wonderful rapidity with which wooden buildings covering acres of ground were erected on Coney Island, we can imagine what must have been the difficulty, if not impossibility, of getting a sufficient amount of wood and lumber at all fit for use prepared by the old "seasoning" processes.

"Vulcanized" wood or lumber is in every way admirably adapted to all such purposes, and can be supplied ready and fit for all uses as rapidly as demanded and at very small expense. "Vulcanized" wood or lumber does not absorb moisture and is a non-conductor of heat; hence houses built of it are cooler in summer and also dryer and warmer in winter.

Building of Ships.

Under this head we include all ships, steamers, and boats of every size and description, whether employed in the navy, in the transportation of passengers and merchandize in our international commerce, or for the purposes of internal trade and communication.

These vessels are built chiefly of wood. While three-fourths of all the products of the earth are inclosed in wood for their preservation and transportation, the vast commerce of the world is borne on sea and land in vehicles made of wood. The wood-work of all vessels is constantly exposed to alternations of heat and moisture, and liable to decay. The destruction occasioned by rot, and the loss annually incurred thereby would be surprising if it could be accurately stated. The rotting of the timbers and other wood-work to which they are subject, involves not only the loss of the vessels and all the labor bestowed on their construction, but also that of valuable cargoes and the lives of human beings.

In the building of steamers, ships and boats the best and most expensive timber is used, and great pains are taken in its "seasoning," which generally requires from three to five years, for the open air method adopted in the time of Noah, when ship building was in its infancy, is still in general use.

The wood-work of vessels is nevertheless liable to destruction by decay. Under the influence of heat and moisture the germinating principle of the vegetable mat-

ter contained in wood is brought into life and activity, which will inevitably result in decomposition by dry-rot, or wet-rot. In timbers, which have remained some time in the dock-yard before they are converted into parts of a vessel, germination or vegetation may commence and not manifest itself externally, and the timbers may appear hard, firm and sound, but in situations and under influences which are numerous in ships, they will in a short time be found covered with fungus, and in a state of rapid decay. Dry-rot once begun will progress even in the dryest portions of the vessel, and under any amount of paint. And timbers which have been "seasoned" even to the very center, will become softened and decomposed by heat and moisture, and rottenness must ensue. The vegetable jucies are only dried by the "seasoning," and the germinating principle still existing in them only remains dormant until by moisture these juices are dissolved and diluted, and vegetation brought into life and action.

Immunity against rotting cannot be secured by the most careful selection, painting, or "seasoning" of the the wood and lumber of boats and vessels, but it can be found in the use of "vulcanized" timbers, "vulcanized" wood and lumber. By "vulcanizing" the vegetable or fluid matters are retained, coagulated, and solidified in the wood and cannot be dissolved, diluted and decomposed by heat and moisture.

The great heat employed in "vulcanizing" destroys the principle of vegetation, or germinative life of jucies in timber.

We have already shown that by "charring," which is but another mode of "vulcanizing," wood and lumber have been preserved from decay for centuries. The "Royal William," one of the most remarkable

instances of durability that the British Navy has supplied, was built either wholly or in part of timbers that had been charred. This vessel was launched in 1714, never repaired until 1757, and when surveyed afloat in 1785, it appeared that the thick stuff and plank employed in her construction had been burnt instead of kiln-dried. See "Treatise on Dry-rot in Timber," by T. A. Britton, London, p. 99.

It is a well known fact, that vast sums expended in our naval architecture are thrown away on account of the perishable nature of the materials employed. Before the late war some of the vessels intended for our navy decayed on the stocks, or were damaged by worms to such extent that it became necessary to replace many of the timbers before those structures were completed. It is also a lamentable fact, that, since the war, our monitors have rotted away in such manner that the mail must be removed, and the wood to which it has been attached entirely replaced. Oak, which is expensive is the only wood now employed for such purposes. "Vulcanized pitch pine" is not only much cheaper than oak, but it is as strong and tough, and far better in many respects. It will not be affected, in the slightest degree by corrosion in contact with the metallic sheathing, and the matting together of the fibres of the wood, in this treatment, renders it so dense and tough that the bolts, spikes and nails will not cause it to split.

"Vulcanized pitch pine" being water-proof, and at the same time rot-proof and worm-proof, should, for the sake of economy and safety, be extensively employed in the wood-work of all boats and vessels, and being of great strength, and practically a non-conductor of

electricity, it is the very best material for spars and masts.

The great superiority of "vulcanized" wood over all other kinds for the construction of fine houses, will be a sufficient commendation for its use in the interior finish, fitting and decoration of boats and vessels to which so much attention is now given. "Vulcanized" wood or lumber will stand without change the atmospheric alternations so frequent upon the water. Hence the woodwork, furniture, musical instruments, etc., of all Boats and Vessels should be made of material so prepared.

Canal Boats, as ordinarily built, rot rapidly, and also become badly water-logged. In this condition their carrying capacity is not only diminished, but all freight stored in them, especially grain, flour, etc., is liable to mildew and rot.

These boats should all be built of "vulcanized" wood and lumber, which will not water-log, which will not rot, and which will need no paint either for ornament or protection.

Note: The Royal William was not finally taken to pieces until 1813, after a service of nearly 100 years.

Furniture.

All buildings, ships, steamers and boats must be supplied with furniture made almost entirely of wood, and all the wood used in its construction has now to pass through some process of "seasoning," however tedious, or expensive.

The best, most substantial, beautiful, and expensive furniture is made of wood or lumber "seasoned" in the natural way, by subjecting it to the open air for from two to five years. An ample supply of lumber seasoned in this manner cannot be had without keeping large stocks on hand, and incurring the loss of interest, taxes, insurance, etc., consequent thereon, as well as the loss of material occasioned by shrinking, warping, rotting, etc., during the treatment.

Greatly inferior and less substantial furniture can be made of lumber which has been "seasoned" by some artificial method requiring less time and expense, but accompanied nevertheless with much loss from shrinking, etc.

The great trouble with furniture arises from the swelling and shrinking of the wood after it has been fitted and joined, and when made of kiln-dried wood it comes apart and breaks to pieces with the slightest use.

Then again, it is necessary for all the "seasoned" wood of which it is now made to be filled or sized with some material, that it may have a smooth surface, resist moisture, and insure a permanent polish. Divers

materials, such as beeswax, copal, starch, pumice stone, plaster of paris, and various gums have been used, but have proved ineffectual. They absorbed the varnish used for polishing, shrank, rolled out, and discolored the wood. Marl, clay, flour, chalk, and various forms of infusorial silicates have been used for filling the grain, with more or less success. It is claimed that finely powdered flint and quartz mixed with oil forms a non-absorbent, transparent substance which fills the pores of the wood, and makes a hard, permanent glossy surface, requiring fewer coats of varnish in polishing.

It may not prove uninteresting to notice here the further handling required by the "seasoned" wood and lumber when used in making furniture.

The process of finishing ordinary cabinet work, very generally adopted, is as follows: give the wood a heavy coat of oil, and let dry for a week, or more; then sand-paper it with boiled linseed oil until the gum of the oil, the fibre of the wood, and the sand from the paper produce a sort of gummy paste, which in the process of time and with much rubbing will lodge in the open pores of the wood, and form a tolerable filling for the grain. Some time is required for the gummy substance to dry thoroughly before the varnish is put on.

The finer quality of work, subjected to what is termed hand-polish finish, requires from three to five coats of what is known as scraping-varnish, each coat, as soon as dry, being scraped off, leaving none of the varnish upon the work except that which adheres to the grain below the surface. After this, from three to five coats of polishing varnish are applied, and the work rubbed with pumice stone and water, and polished with rotten stone and the open hand.

Many imported and expensive woods, such as ma-

hogany, are extensively used in the manufacture of furniture, and these need to be kept a very long time, not only to "season" them, but to develop the richness of their coloring.

Through the "Vulcanizing Process" lumber well *cured* and prepared for use can be furnished as rapidly as needed from small stocks, and without the loss of time and money incurred in the various processes of seasoning now employed.

"Vulcanized Lumber" with its cemented fibres, uniformity of surface, and smoothness of grain can be so highly finished, so nicely shaped and fitted, and so neatly and firmly joined, that the artizan will find great pleasure in the beauty of his work, and infinite satisfaction in knowing that it will stand. The doors of wardrobes, and the drawers of tables and bureaus can be fitted closely and yet open and shut at all times without difficulty.

In "Vulcanized Lumber" the pores are closed, and the surface of the grain is made smooth with the solidified fluid matter of the wood, which is the most natural and best filling, so that it readily takes glue, and will receive a beautiful and lasting polish without elaborate and expensive preparation.

"Vulcanizing" also brings out the grain and coloring, and develops all the natural beauties of the various woods. The dark rich appearance given to mahogany and other expensive woods by age is produced by "Vulcanizing" in a few hours. It would be difficult to estimate the many benefits which the 50,000 cabinet makers of this country will derive from the discovery of the art of "Vulcanizing" wood.

Pianos and other Musical Instruments.

The manufacture of pianos has become one of the important industries now growing so rapidly with the growth of our country. A large amount of the very best kinds of lumber is required in this business. Piano cases must be made of sound, strong, substantial wood, and should be finished in the most attractive styles with woods of the greatest beauty and highest susceptibility of polish and ornamentation.

Manufacturers keep large stocks on hand for many years from which they select lumber for these purposes with great care, and then subject it to some artificial process to make sure of its thorough "seasoning." The wood-work is all fitted and joined with the greatest exactness and finished with the most artistic skill.

Unfortunately the wood and lumber however well "seasoned," carefully selected, and skillfully joined and ornamented, cannot withstand atmospheric changes. The cases made of them are seriously affected under the influences of heat and cold, wet and dry, as will be shown in the swelling and shrinking, warping and cracking of the wood. The absorption of moisture by the wood of which any musical instrument is made destroys all strength and brilliancy of tone.

"Vulcanized Wood" will not absorb moisture, swell or shrink, crack or warp like wood which has been subjected to years of seasoning whether natural or artificial. It is stronger and more durable, better *cured* and

prepared for use, more easily shaped, fitted and joined, is more beautiful, and capable of a finer polish and higher ornamentation, and it is also far more resonant, and in all essentials superior to any merely "seasoned" wood for the construction of pianos, organs, or any other kinds of musical instruments.

Farm Implements and Machinery.

In 1870 the value of all the farming implements and machinery of this country was estimated at $336,878,429. The materials of which they are made consist chiefly of wood. In the construction of some of the most important implements such as reapers, ploughs, etc., the very best of "seasoned" wood is now employed. To provide themselves with what is called the "best of seasoned material," manufacturers purchase large stocks of green timber and keep it from three to four years to "season" it.

By exposure to atmospheric changes and influences during this long and tedious process of seasoning, much of the large stocks of timber is rendered useless by warping and cracking, by powder post and by ordinary rot, and it is only of the best of what remains that the implements are generally made. The losses thus incurred are of course put upon the purchaser by the increased prices at which they are sold. On the farm they must be kept well painted and under cover when not in use, and even then they are liable to constant injury and destruction by the warping, cracking and rotting of the "seasoned" wood of which they are made.

There are no means of ascertaining with any degree of accuracy the loss resulting from the decay of the wood-work of farming implements. Some idea of it may be formed from the fact, that there are 3,076 establishments in the country with near $50,000,000 of

capital, which employ 35,249 hands in the manufacture of farm implements to supply the annual demand

"Vulcanized" wood or lumber should be used in the manufacture of all farming implements and machinery. It is tough and strong, will not shrink, warp or crack, nor will it rot when exposed to the weather. Implements of "Vulcanized" wood need no protection from paint, nor do they need shelter.

If "vulcanizing" could do no more than cure and prepare wood for use in the short period of a few hours, that alone should entitle it to be considered one of the greatest improvements of the age.

Fencing.

The preservation of fencing materials is assuredly one of the most important uses to which the process of "Vulcanizing" can be applied. Some years ago Jno. S. Skinner, while editing the "*Plow, Loom and Anvil*," after a very painstaking investigation of the subject, in a series of papers set forth his conclusion from all the information in his possession, that the setting and repairing of the fences of the United States cost as much as the building of the cities and towns. According to a report of the Agricultural Bureau made in 1871, there were in this country 250,505,614 acres of land under fence; the total cost of the fencing was estimated at $1,747,549,931; and the annual expense of maintaining the fences (including interest an original cost), amounted to $198,806,182.

If the fences of the United States were preserved from destruction by rot, there would be a saving of $1,012,000,000 in the expense of repairs every ten years.

The process of vulcanizing is effectual in preventing the decay of wood. It is simple and inexpensive and can be applied to fencing materials of all kinds. When the farmer, at great expense of time, labor and money, surrounds his yard and garden with beautiful palings, and his orchards and fields with well arranged fences, he will find infinite satisfaction in the thought that these valuable improvements will in permanent form descend with the land as an inheritance for his children and his children's children.

Building of Carriages and Wagons.

In the manufacture of carriages, etc., only the very best selected and prepared material should ever be used. Fortunately for those who are able to indulge in such vehicles, the builders of them are for the most part remarkably well posted as to the strength, durability, quality and condition of all the kinds of wood and lumber needed in their line of business. The carriage maker, however, like the cabinet maker, labors under the disadvantage of having to "season" all his material by a tedious, expensive and unsatisfactory process, and of taking it through an elaborate course of priming and filling as a preparation for its finish by varnishing and polishing.

He is also under the necessity of carrying heavy stocks of wood and lumber, and during the many years required for seasoning incurs loss by shrinking, cracking, warping and rotting, and in addition thereto a considerable loss by the destruction of certain kinds of timber for spokes, felloes, shafts, etc., by what is known as *Powder Post*. Of all the workers in wood none can more fully appreciate the "Vulcanizing Process" than the builders of carriages and wagons. To them, wood which is *perfectly cured and thoroughly prepared for use, with smoothly laid grain and well filled pores, which is tough and firm and full of life and strength* needs no commendation.

NOTE. The builders of carriages and wagons use a large amount of "second growth" timber, and they lose heavily every year by its de-

struction from "Powder Post." In "Powder Post," sometimes described as "Insect or Animal Rot," the wood is converted into powder by the ravages of a worm, with which it is infested. It is supposed that this worm is produced from eggs deposited in the green sappy wood by a fly.

"*Vulcanizing*" *will prevent* "*Powder Post.*" *The great heat used in this process will destroy the germinative principle of the eggs and no worms will ever be produced.*

The fitness of "Vulcanized Wood" for Telegraph and Telephone poles, cross pieces, and underground boxes.

In an interview lately published in the "New York Herald," Mr. Jay Gould is represented as saying that "the western union telegraph company has over one hundred thousand miles of poles constantly rotting, and being replaced." This is by no means an over statement.

The various telegraph and telephone lines of the whole country embrace about 162,364 miles, and employ 6, 494, 560 poles which last on an average about ten years. The number of new poles annually required therefore for the replacement of the old ones is 649,456. The cost of these (including transportation, the labor of taking down the old, and putting up the new poles, and the readjustment of the wires) estimated at $5.00 each, amounts to $3,247,280.

This large annual loss can be saved by the use of poles which have been subjected to the "process of vulcanizing." By this simple treatment they will be preserved from decay, and also made tougher and stronger, and at a very trifling expense.

"Vulcanized pitch pine," which will never rot and is as strong as oak, and practically a non-conductor of electricity, for poles, and brackets or cross pieces, and for the boxes employed in passing wires and cables under ground, will be found in all respects the very best wood ever used for such purposes.

"Vulcanized Wood" useful in Breweries.

The brewing business now constitutes one of the most important industries of this country. The many vats, tubs, casks, barrels, kegs, pipes, troughs, etc., of the brewery are made of wood which is in constant contact with fermenting elements, and liable to rapid decomposition.

"Vulcanized wood" should be used for these purposes, because it resists decay in all situations and under all influences. The expense now incurred in lining beer tanks, casks, etc., with coatings of pitch and rosin to prevent their destruction by rot can be saved by the use of "vulcanized" wood. If it be urged that the rosin thus employed for preserving the wood from decay, subserves the purpose of imparting some desirable quality to the beer, "vulcanized pitch pine," which is thoroughly filled with rosin, will be found suited in this and in all respects to the brewers uses.

In one of the largest breweries in this country there is but one vat which remains perfectly sound, while all the others in spite of their linings of pitch and rosin are constantly rotting. The one sound vat was made of charred lumber taken from a burnt building. The great heat to which this wood was subjected produced a change in its nature, destroyed the principle of vegitation in its fluid matter so that it resists the effects of fermentation, illustrating to some extent the great value of the "vulcanizing process."

Damage to Lumber during Shipment.

Lumber is more or less affected by rot during transportation by water. The disease may be imparted by the vessel, but it is generally produced in the lumber itself under certain atmospheric influences, and few cargoes escape its ravages.

The extent of damage from this cause depends upon the length of the voyage, the state of the weather, and the condition of the lumber when shipped. If it is shipped in a tolerably dry condition, the rot may show itself only in discolored spots here and there on the surface of the wood, accompanied perhaps with a slight growth of white fibers. But if shipped in a wet state, and if the voyage has been a long one, the whole surface of every piece of lumber will be found covered with a net work of small white fibers, and the boards often so matted together that they cannot be separated without force, and after quitting the vessel they will grow together again on the barges before being landed.

This fungus growth is dry-rot in its incipient state, and some times penetrates to the depth of $\frac{1}{8}$ of an inch. It is vegetation produced when the germinative principle in the juices of the wood is brought into life and action by heat and moisture, and if not arrested it will soon greatly damage or utterly ruin all the lumber in which it makes its appearance. Careful scraping or sweeping of lumber thus affected and then piling it upon edge will only retard the progress of the disease. "Vulcanizing" will effectually cure it. "Vulcanizing," by destroying the germinative principle existing in the

fluid matter of wood, will not only arrest, but prevent vegetation. Hence "Vulcanized Lumber," whether shipped in a dry or in a wet condition, will not be affected by rot during transportation, whatever may be the state of the weather, or the length of the voyage.

We have the authority of a distinguished English architect for stating that no cargoes of lumber, whether in the log or in board, arrive in England from Canada, or from the United States, in a perfectly sound condition.

Bridges, Wharves and Piers.

These are the most expensive works within the whole range of the Mechanic Arts, and to be permanent should be made of the most durable material. It is of great importance therefore that "Vulcanized" wood and lumber be employed in their construction.

An enormous expense is incurred every year in the rebuilding and repairing of bridges in this country, rendered necessary by the rotting of the material of which they are constructed. In spite of careful watching and repairing, the decay of a single timber is sometimes attended with the most disastrous consequences involving great loss of life as well as of property.

Bridges of "Vulcanized" wood will prove as strong, lasting and safe as those of iron, and can be built at much less cost. They will need no coverings, no sidings, no coatings of paint to protect them from the weather, because "Vulcanized" wood will not rot in any exposure.

Bridges are sometimes constructed over water on piles, which are exposed to the ravages of the Teredo and other destructive worms which infest salt water especially in Southern latitudes. By the insidious attacks of these borers the strength of the largest pile timbers is frequently weakened and utterly destroyed in a few months, and before any damage is even suspected. The piles, beams, railings and cross timbers employed in the construction of wharves, piers, etc., are also liable to rapid decay and to destruction by these worms.

"Vulcanized pitch pine" will not decay, and a test made of it, in Biloxi Bay on the Gulf coast, has demonstrated that worms will not bore into it. It is therefore the best timber not only for piles, but for all the purposes for which wood is required in harbor works.

NOTE. According to Col. Berrien, the Michigan Central R. Road Bridge, at Niles, was painted *before seasoning*, with "Ohio fire proof paint," forming a glazed surface. After five years it was so rotten as to require rebuilding.

"*Vulcanized*" *timber would have needed no seasoning, and no painting.*

NOTE. A bridge on the Louisville and Nashville R. Boad, near Clarksville, Ten., gave way a few years after its construction. This was caused by dry rot in an important key post.

NOTE. It is said that the "Teredo" will not go into wood which does not absorb water, and that it cannot digest rosin. Pitch pine when "vulcanized" is full of rosin, and will not absorb water.

Levees and Dykes.

The rich lands in the lower Mississippi Valley bordering on the river, by a proper system of levees, will yield untold wealth to the individual proprietors, and to the nation. There are also swamp and overflowed lands in the American bottom opposite St. Louis, in the New Jersey swamps opposite New York, and in various portions of this great country which by being properly dyked and drained can be thoroughly reclaimed, and made immensely valuable.

The sugar and cotton lands of the South have been to a great extent utilized by the embankments or levees to prevent their overflow. These have been built, at great expense, of earth alone composed of *sand* and *loam*, and hence alluvial and unreliable. The *new* or green levee, not having settled and acquired solidity by cohesion, is often swept away by the first rise in the river. The *old* levee, which in time has become firm, is often perforated and honey combed by crawfish and muskrats at points where it is highest, and has the greatest service to perform. Experience has shown that wherever the water is allowed to pass an embankment, either through crawfish or muskrat holes or by overflow, a crevasse is made and the whole country overflowed for miles.

In this region stone might be employed to good purpose, but it cannot be had. Neither stone, gravel, nor coarse sand is found on the *alluvial banks of the lower Mississippi*. Although along the whole valley timber

of various kinds is abundant, there has not been any application of wood to levee purposes, nor has attention been directed to any well digested plan for its use. Within a few years, however, a patent has been granted for a method of combining wood with earth in the construction of dykes and levees. The inventor proposes that planks about nine inches wide, from two to three inches thick, and of the requisite length, with concave and convex edges, and wedge shaped at one end, be fitted into each other, and placed in a row between two pieces of timber so joined together as to admit the planks and serve as a guide for them ; that the planks thus arranged between the timbers, be held together at top by a movable cap, and driven by machinery to the required depth ; that the boards shall then be fastened together by a latteral brace, and dirt thrown up against them from the inside. A levee constructed in this manner will not be liable to the inroads of rats and crawfish, and in case of overflow, the water will fall over it as it does over a mill-dam, and crevasses will not be formed by the washing away of dirt.

He proposes to use wood in the same manner in making dykes for the reclamation of swamp and overflowed lands.

When the planks, jointed as above explained, are driven down in sections, and the water pumped out from the land to be drained, the loam is to be thrown up against the wooden barrier from the inside, so that no overflow or seeping from ocean or river will again interfere with the cultivation of the territory thus protected.

These suggestions are admirable, but are based of course upon the idea that the wood used for these purposes shall be *preserved from decay.*

"Vulcanizing" is a simple and cheap method by which wood for all purposes can be effectually *preserved from decay*, and hereafter in the construction of dykes and levees, works of such importance that they have become national in their character, the use of the "vulcanizing process" will be found of inestimable value.

Persons of great experience in building such works, have expressed the opinion that by the combination of timber with earth as proposed above, levees more lasting and more effective than those of earth alone, can be built for one-half their cost.

Casks, Barrels, etc.

We annually require millions of casks, barrels and kegs, and a vast amount of timber is employed in their manufacture. A large proportion of the packages intended for transportation, both in our domestic trade and in foreign commerce, are put up in this form. The contents of such packages probably represent more than one-fourth of the market value of the elements that enter into the commerce of the world. The certain exposure of such packages to all the changes of temperature and degrees of moisture results in an incalculable waste of valuable merchandise. Hence barrels of all sizes, and for all purposes should be very carefully made and of the best material. The wood employed in their manufacture should be so prepared as to resist effectually the ordinary action of the elements.

Coopers understand this fully, but they have great trouble in preparing their timber by the old method of "seasoning." They are compelled to employ capital at a loss of interest in keeping large stocks of raw material on hand, much of which is rendered unfit for use and destroyed by rot and worms during the time required in "seasoning."

By the "Process of Vulcanizing" all their stave and hoop timber can, in a few hours and at very small expense, be thoroughly *cured* and prepared for use and made to serve its purposes far better than any merely "seasoned" stuff.

Burial Cases.

The desire to preserve the remains of the dead has led to the extensive use of metallic caskets. These are not only expensive, but inconveniently heavy and liable to corrosion in contact with the earth. While they may last longer than coffins of ordinary wood, it is questionable whether they will not be entirely destroyed by corrosion in 15 or 20 years time.

"Vulcanized wood" will not rot, and is the cheapest, most lasting and most suitable material of which burial cases can be made. Caskets of "vulcanized" pitch pine will not decay in centuries, and can be so finished and polished as to present as beautiful an appearance as those made of mahogany or rosewood.

Ice-Houses and Refrigerators are now constructed with double casements filled with charcoal, saw-dust, plaster of paris and various other substances, and all the wood employed is liable to rapid decay.

"Vulcanized wood" will not rot, and being a non-conductor of heat is admirably suited for ice-houses, ice-chests, etc.

"Vulcanized pitch pine" is a perfect non-conductor of heat, and is at the same time susceptible of the highest finish and ornamentation. A refrigerator made of it will need no double casements, and can be given the beautiful appearance of the handsomest piece of furniture.

Collieries and other Mines.

In mines all the wood used in props, in horse, and engine ways, and in hoisting machinery decays in a very short time. A great saving can be made in the use of "vulcanized" wood for all these purposes, especially in the many gold and silver mines of the country located in regions where timber is scarce and purchasable only at very high prices.

The mines on the Comstock Lode in Nevada use from 40,000,000 to 50,000,000 feet of timber every year, involving the clearing of 3,500 acres of forest land.

The cost of logs together with the expense of transportation is annually increasing as the supply becomes more limited.

In the "South Durham," the "Tanfield Moor," the "Mickley" and other Collieries of Great Britain the props of untreated timber formerly used, had to be replaced every six or nine months. *Preserved timbers only* are now employed in those mines, and the expense of replacement is saved.

Vulcanized wood superior to all other material for the construction of pavements.

"No pavement which greatly increases the destruction of shoe, horse, vehicle, ease, comfort and convenience is economical, though it may cost nothing and last forever."

"Many thousands of dollars worth of shoes, horses and vehicles can be worn out on a few thousand dollars worth of pavement."

In the construction of cities and towns, strips of land are left open to furnish light, a free circulation of air, and convenient ingress and egress for the adjacent houses. These streets are highways belonging to the public, and under the control of the inhabitants of the city or town to whose uses they have been dedicated. As public highways they should remain open, and should be improved in such manner and kept in such condition that they will supply the purest air, afford the greatest facilities for the movement of people on foot, on horseback, or in vehicles, and the transportation of freight, and best promote in every way the comfort, ease, convenience and welfare of all for whose accomodation they are intended.

It is all important therefore that they should be laid with the best pavement.

The best pavement is one of such construction and material as will afford and maintain a smooth and even surface, and yet provide sure foothold for horse and man; such as will be firm and durable to resist the

action of iron shoes and tires, and yet not so hard and solid as to render resistance shocking and damaging to the feet of horses, and the wheels of vehicles, and by concussion produce a deafening and unendurable noise; such as will insure an even and steady pressure of the wagon, diminish the obstruction to wheels, render the draft of horses more effective ; such as can readily be kept clean, and be easy, comfortable, and safe for walking, riding, driving, etc.

When we consider the kind of pavements now generally in use, and see their unfitness to subserve the purposes for which they were intended, it seems surprising that those who own, control, and use the streets of cities and towns should be so inconsiderate of their own interest and provide so poorly for their own welfare.

The "cobble stone," for a long time the most popular pavement and still in very general use, is perhaps the very worst pavement ever devised. A street laid with round, smooth, hard, flinty boulders could not fail to present the most uneven surface possible, and an endless succession of unyielding obstructions to travel whether it be on foot, on horseback, or in wagons. On such a pavement no proper resting place can be found for the foot of horse or man ; wheels, losing the benefit of their circular form, roll from stone to stone with a polygon motion, while vehicles are swerved and wrenched from side to side with a banging, battering, and clattering, which racks and distracts both team and driver. Dirt and filth readily accumulates between the stones, and at times seems to tone down to some extent the harsh surfaces of this pavement, but when with the sharp corners of hoes and shovels the dirt and filth

is picked and scraped from the angular crevices in which it has collected the former roughness is restored. This absurd "cobble stone pavement" seems a wicked device invented for the torture of man and beast, and the destruction of wagons and carriages. *Unfortunately it costs but little and lasts a very long time.*

Stone is employed in other forms of pavement with somewhat better results. The "Belgian," for instance, is an improvement upon the "cobble stone." Its general surface is more even, and it is in other respects less objectionable, but the blocks are unevenly cut, and when newly laid present irregular and prominent points, which in contact with the wheel throw the axle out of a straight line and produce a jarring motion. The rough surfaces of the blocks wear off in the course of time, and become so smooth that they no longer afford a proper foothold for horses.

Next comes the "Russ pavement" by some considered an improvement on the "Belgian" which it is rapidly superseding, but they both fall far short of possessing the indispensable requisites of a good pavement. The "Russ," when laid with care has at first a tolerably flat surface, but the stones soon wear off at the edges, and become so rounded at the top that wheels roll over them as they do over the small poles with which the country "corduroy" roads are laid. Though more flat and even than the "cobble stone," this pavement furnishes poor foot-hold for horses and hundreds slip and fall on it daily.

The "Russ" and the "Belgian" like the "cobble stone" are durable, but this is the only requisite of a good pavement which can possibly be claimed for them. The concussion between the wheels of vehicles, and the stone or granite of which they are con-

structed flattens the felloes and tires between the spokes, strains and breaks the tires, spokes, springs, and axles, starts and rattles the nuts, bolts and joints, and destroys the whole running gear in a short time. Concussion with their hard unyielding surfaces bruises the feet, ossifies the joints of horses and wears and jams the life out of them in few years time. The concussions between the feet of horses and the wheels of vehicles, and these pavements combined, produce an incessant thundering, deafening and almost insufferable noise, which late at night, early in the morning, and throughout the whole day interferes with conversation, hinders the transaction of business, destroys the comfort, disturbs the rest and exhausts the nervous energy of the sick and the well.

The shoes of horses, and the tires of wheels are by attrition rapidly worn away on these pavements, and the stones become glazed with a metal polish, which even in dry weather renders them as difficult of foothold as if they were made of smooth, solid iron.

In wet weather these pavements are covered with a peculiar kind of mud in the composition of which triturated stone and metal enter largely, and this not only adheres to vehicles, and takes off paint and varnish, but renders the sidewalks almost impassable, and the streets too slippery for people to cross or horses to travel with safety.

Another form of pavement is much used in which stone is the only material employed. It is known as the "Macadam." This is in many respects a good pavement for pleasure travel in parks and suburban towns, where they can be watered constantly and never allowed to get out of repair. When first made it is but a continuous bed of small stone presenting an infirm and

uncertain surface, which can be solidified and brought into shape and form for agreeable use only by the hammering and pulverizing effect of travel. This style of pavement is not adapted to the general use of cities. After it has been worn down to a firm and even surface the heavy traffic of the city grinds and pulverizes it into a fine powder, which in wet weather takes the form of a thin mud with which horses, harness, vehicles and people are bespattered, begrimed and soiled, and in dry weather rises and fills the air with clouds of suffocating dust injurious to health, ruinous to dry goods, clothing, and furniture, rendering life even in luxurious homes almost intolerable.

A pavement properly constructed of "compressed asphalt" is in many respects a very good one. Being inpenetrable by the moisture of the earth beneath, it is always very dry and dust forms upon it rapidly. The cost of construction, the necessity for constant and careful repairs, its applicability only to streets on levels, the difficulty which the horse finds in maintaining his footing upon its hard, smooth surface, constitute the greatest objections to it.

The "wooden block pavement" was introduced in this country some years ago, and adopted very generally in the eastern and western cities. In localities where wood is cheap and stone scarce it is still extensively used. This pavement was found to be smooth, even, quiet, clean, elastic, and more agreeable to man, and less injurious to horses and vehicles than any pavement of hard, solid, unyielding stone or granite, and to have all the indispensable qualities of a *first rate pavement*, except that of durability. It can be demonstrated that this want of durability was due to the imperfect manner in which it was constructed, and that wooden blocks,

properly prepared, are the very best paving material that can be found.

The easy, comfortable, safe and delightful travel afforded by "wood pavement" when first laid created a popular furor in its favor. Such was the rage for it, and so rapidly was it petitioned for, regardless of cost, that contracts for its construction became the subject of speculation. Contractors taking advantage of the popular feeling secured through "ring rulers" the laying of large areas of cities, and rushed the work through as soon as possible to be ready for another "job." The material generally employed was wholly unfit for use, and the pavement was constructed in the most careless and unworkmanlike manner. On an infirm bed of sand were crowded together in rows, and side by side, blocks of wet, green, soft, sappy pine wood, often in a state of incipient decay. Between these rows were left spaces of an inch or more so imperfectly filled with gravel and tar, that the water passing through them would wash away the sand foundation, then under the pressure of the wheels the superstructure subsided, causing small depressions, which grew larger until all evenness of surface was destroyed, and the decay of the blocks of such perishable wood was hastened by the accumulations of water and filth. The interposition of boards of a like perishable nature, between the sand and the blocks only delayed these results until the boards, had time to rot. The practice of tarring proved but a delusive device, which insured the more rapid rotting of the blocks and boards. The coating of tar by closing the cells, and preventing all escape of moisture, only induced and hastened fermentation, which at once destroyed all strength of fibre in the wood, and resulted

in the rapid wearing away of the blocks by disintegration, or their total destruction by decomposition.

Thus constructed, and of such perishable material, it is not surprising that wood pavements did not prove as durable as was desired. When we consider the vast amount of traffic drawn from other thoroughfares to streets laid with these inviting pavements the wonder is that they did not wear out sooner. Under all these disadvantages, however, they lasted long enough to effect a saving in the wear and tear of horses and vehicles of a sufficient amount of money to cover many times their cost of construction.

"Wood pavements" when first introduced into England did not prove quite successful. When by competent engineers they were constructed after an improved method, and only of wood *preserved from decay*, they not only gave entire satisfaction, but were found superior to all other pavements. In London and other large cities broad areas of heavily worked streets, hitherto laid with stone or granite, have been paved with wood.

The comparative merits of wood, asphalt, and granite pavements have been fully tested by Col. Heywood, engineer of the city of London. He has ascertained the fact that with the same expenditure of force, a horse can travel 132 miles on granite, 191 miles on asphalt, and 415 miles on wood before an accident occurs. He reports that the whole number of horses falling, during a test of 50 days, was 2,327, of which 1,066 fell on asphalt, 719 on granite, and only 542 on wood, and that a horse after falling recovered himself much more easily on wood, than on either stone or asphalt.

Pavements made of blocks of *perserved wood* have proved very durable. In Oxford st., London, where the

traffic is equal to 300 tons pr. foot pr. day, the wear has been found to be from $\frac{1}{16}$ to $\frac{1}{8}$ inch during three and a half years. In "Great Howard" street, Liverpool, with a traffic consisting chiefly of carriages, amounting to about 94,000 tons pr. annum, pr. yard in width, the blocks have worn to the extent of $\frac{5}{8}$ inch in 4 years. It is estimated that the wear of the wooden blocks in the city of London with the heaviest traffic is $\frac{1}{8}$ inch pr. annum. At this rate a block would be reduced from 6 inches to 3 inches in 24 years.

Thus in England, where wood pavements have been properly constructed, and of *preserved wood*, which did not rot, they were found durable and approved, while in this country, where they have been poorly constructed, of perishable material, which very soon rotted, they were not found durable and were condemned.

There is no longer any doubt that for a good, solid, firm foundation or road-bed, regarded by English engineers as the *true* pavement, wood furnishes the best *wearing surface*, and that wood is very durable as long as it remains *sound and strong in fibre.*

In practical mechanics it is found that the forces of concussion and friction are attended with less attrition and disintegration — *wear and tear* — when substances dissimilar in nature and density are brought together. Hence the farmer drives his iron wedges with a wooden maul, and not with a sledge of stone or granite; he wears his scythe to an edge by bringing it in contact with a grind-stone, and not with a revolving piece of wood; the stone-worker uses a wooden mallet upon his steel chisels, but saws large blocks of stone with smooth blades of iron.

It is not strange then that wood should wear less

than stone in contact with iron shoes and tires, or that iron shoes and tires should wear more rapidly in contact with stone than with wood.

The practical tests in England, however, have removed the only possible objection to wood pavements by demonstrating that *they can be made lasting, that wood is a most durable paving material as long as it is sound and strong.* In America an inventor has discovered a method of *keeping wood sound and strong* by the simple and inexpensive process of "Vulcanizing." This treatment will not only preserve the wood from rot, but develop in it qualities of toughness and strength which will greatly increase its durability.

The soft and sappy woods can by this process be *cured* and solidified into excellent material for paving purposes. The "Pitch Pine," so abundant in the south and a very cheap wood in all accessible markets, when "vulcanized," will furnish the best paving blocks that have ever been used. They will resist decay, and prove as tough, firm and enduring as pine knots, while the rosin developed in them will prevent the slipping of horses.

The people of this country evidently growing weary of the noise, dirt, damage, discomfort and inconvenience of stone pavements, and not insensible to the manifest cruelty and inhumanity of driving horses over them, will at no distant day come back to wood pavements, and adopt the thorough English method of constructing them.

With a foundation firm and solid, laid with "*blocks of vulcanized wood,*" a pavement possessing all the indispensable requisites can be furnished for the streets of our cities and towns; a pavement which will present a smooth, even surface and yet provide sure

foot-hold; which will be firm and durable, yet not so hard as to render resistance shocking and damaging to horses and vehicles; which will insure an even and steady pressure of the wagon, diminish obstruction to wheels, and render the draft of horses more effective; which can be easily kept clean, and upon which travel on foot, on horseback, or on wheels will be easy, comfortable and safe, and not attended with deafening and unendurable noise. With such a pavement along all the thoroughfares and avenues business can be transacted without constant interruption and annoyance, and the pleasures of homes enjoyed in some sort of peace and comfort.

With an agreeable roadway running by his door, a man will not be compelled to travel several miles in torture to find a road upon which he can take a short pleasure drive.

A Model Pavement.— The following plan for making a model pavement has been suggested by an eminent engineer:

Make a solid substantial foundation of bituminous or cement concrete ; spread upon it a thin layer of pitch, supplied with a sufficient quantity of oil to make it slightly but permanently plastic ; upon this, while hot, set blocks of "vulcanized wood" in rows, driving, them closely together ; between the rows, use strips of tarred felt, and make close joints ; then pour melted pitch over the whole surface, taking care to fill every crevice ; upon this spread fine sharp gravel or sand. No water can penetrate this pavement, it will not therefore be injured by frost, and the drainage will be solely on the surface. The "vulcanized" blocks will not absorb moisture, and will not therefore be thrown out of place by expansion.

It has also been suggested, by one who has given great attention to the subject, that blocks of "vulcanized wood" (especially pitch pine) eight or nine inches in length, laid on a sand foundation, as blocks of granite are now laid in the "Russ" pavement, will be found the most agreeable and durable pavement which has yet been tried.

[From the "Sun."]

A FIFTH AVENUE NUISANCE.

Fifth Avenue, between Twenty-sixth and Twenty-seventh streets, has been experimentally paved by some private enterprise with a material into the composition of which asphalt enters largely. It has become exceedingly hard and smooth, and is consequently very dangerous to drive upon. Mr Brewster, the carriage builder, says that fifteen or twenty valuable horses belonging to his customers have fallen and been severely hurt on that treacherous piece of pavement. Mr. Kemp, of Lanman & Kemp, had a team thrown and injured upon it the other day. Some of the gentlemen who have been subjected to such accidents are contemplating measures to make the city responsible for the injury to their horses sustained here.

What is the value of the Process for "Vulcanizing" Wood.

We have called attention to a few of the arts and industries which will be benefited in an especial manner by this new process, but so long as the vast forests overspreading our broad domain supply us with wood and lumber to so great an extent that no accurate account can be kept of the amount consumed, and no correct estimate be made of its value, it will be impossible to enumerate all the uses and set forth all the advantages of the "Vulcanizing" treatment.

What is the value of a simple and inexpensive process whereby millions upon millions of thousands of feet of wood and lumber for countless purposes can be prepared for use as rapidly as demanded, without the loss of money, time, labor and material incurred in "seasoning?"

What is the value of a simple and inexpensive process whereby wood and lumber required for all the mechanical arts can in a few hours be so treated that its own natural fluids will supply the place of artificial filling, priming and sizing?

What is the value of a simple and inexpensive process which will, in a few hours, make wood and lumber tougher, stronger and more durable for all purposes?

What is the value of a simple and inexpensive process, which imparts to all kinds of wood and lumber greater beauty of grain and coloring, and a higher capacity for development and illumination by finish and polish?

What is the value of a simple and inexpensive process by which perfectly green wood and lumber can in a few hours be thorougly *cured* and rendered fit for use?

What is the value of a simple and inexpensive process by which all the wood and lumber treated by the natural and artificial processes of "seasoning" can in a few hours be put into a condition fit for use?

What is the value of a simple and inexpensive process by which all the wood and lumber employed on sea and on land can be preserved from decay?

The "Vulcanizing process" will accomplish all this. Its value can only be measured by its scope and power of usefulness, which are almost without limit.

The process discovered by Henry Bessemer is a very simple one whereby a slight change is made in iron, which gives it the qualities of steel. His invention has been esteemed of such value that he has been knighted by his own government, has received the Albert gold medal of the society of Arts, and also a gold medal struck in his honor by the King of Wurtemburg. The knighthood of the order of Francis Joseph has been conferred upon him by the Emperor of Austria, and the grand cross of the Legion of Honor awarded him by the late Emperor of the French. In addition to these tributes he has received in the form of royalties, to use his own language, "1,057,748 of the beautiful little gold medals which are issued by the Royal Mint with the benign features of her most Gracious Majesty stamped upon them." That is, he has already realized in royalties on his patent a sum equeal to $5,287,740 of our money.

As an evidence of the great value of this invention the "London Times" gives the calculations of Mr. Price Williams to show, that the substitution of Bessemer steel rails for iron rails will in 15 years prove a saving to all the railways of England of $850,000,000.

A slight change in the nature of wood, produced by the simple process of "Vulcanizing," improves its quality, and increases its durability as much as the "Bessemer process" improves the quality, and increases the durability of iron; the substitution of "vulcanized wood," for the perishable material employed in the fences of the whole country, in the railroad ties, and telegraph poles of all our lines, will in 15 years prove a saving of $2,943,507,000.

The ingenious devices of Thos. A. Edison, the famous American inventor, for the generation, subdivision and employment of electricity as an illuminating agent, whereby it is thought a better light than that produced from gas can be supplied at one third of the cost, are valuable inventions, and the stock of a New York company based upon them has lately sold for $4,000 and $5,000 per share.

According to the census of 1870 there were in the United States 390 Gas companies employing a capital of $71,773,394. Their gross annual product is estimated at $32,048,851, and their net product at $14,532,744. The cost of the product, in wages and material, is therefore $17,416,107. Two thirds of this sum which is to be annually saved by the substitution of "Electric" for "Gas" light amounts to $10,944,106.

The substitution of "vulcanized wood and lumber" for the constantly rotting material employed in the fences of the United States will cause a saving of the annual cost of repairs, which amounts to over $113,000,000. In the State of New York alone the saving in the annual cost of repairing fences would amount to $12,000,000.

The possible results of these great inventions of Bessemer, and Edison, already slightly appreciated by

the public, are thus compared with what the "process of vulcanizing wood" will accomplish, even when limited to but few of its uses, in order to show the great value of each, and to illustrate in some measure, the beneficent power of inventive genius in the discovery, development and employment of the forces of nature.

Vulcanizing meets an exigency of the Present Age, Seasoning only a temporary expedient of the Past.

We live in an age of unprecedented progress, for which we are greatly indebted to the discovery of new forces, and the invention of new methods for their development and utilization.

New discoveries and inventions, entering into all our national arts and industries, embracing every branch of manufacture, covering every field of agriculture, and interwoven with business in every department, have in the last half century brought about a new civilization. To the inventive genius of our people are we in a great measure indebted for much of the glory and prosperity of the country. The need of a great improvment is scarcely felt before it is supplied, if it has not already been anticipated. We arrive at one stage of progress only to be furnished with new methods and greater facilities for further advancement. One invention leads to another, and creates a necessity for many others.

By the stage coach, an improved method of rapid transit in its time, we could travel 75 miles a day, and enjoy mail facilities for an interchange of business messages every week or two. We can now move in all directions from 40 to 60 miles in an hour, can be whirled across the continent in a few days, and have an interchange of messages with the remotest parts of the earth in a few moments.

With devices of the past age, then considered remarkable and ingenious labor saving contrivances, a

woman could spin three miles of thread in a day, and weave several yards of cloth in a week. Through improved methods of employing natural forces, a girl of 15 now spins in a day a thread 2,100 miles in length, which would reach from Washington city to the State of California, and 1,300,000 persons employed throughout the world are doing work, which, if done by the old spinning wheel and hand loom, would require the labor of every individual upon the face of the earth. We have in this country 92,209 engines capable of performing the labor of 14,048,000 men, and 17,084 locomotives doing the work of 29,676,960 horses on the common road. In Garsed's manufactory in Philadelphia one engine, with only seven tons of coal, does the work of 70,000 men. The State of Massachusetts in her engines (including locomotives) has a power equal to that of eight millons of laborers. Yet in the eyes of the inventor, the engine is only in its infancy.

Improvements in the plow have increased its capacity until we can bring annually under its influence more than 188,000,000 acres of our fertile soil; we have been supplied with the cornplanter, the seeder, and the cultivator, and all the new inventions needed to produce from this vast acreage crops never before equalled.

With the production of these large crops, has grown a necessity for other improvements, in supplying which the creative power of the inventor has been illustrated.

The cradle when invented by a man in Scotland was described as "a most marvellous machine for cutting grain, as it would do as much work in a day as seven men with a sickle." The harvester of the American inventor will cut as much grain in a day as 300 men with a sickle, and at the same time do the work of almost as many binders.

The 2,021,000,000 pounds of cotton, constituting one year's crop, could not have been cleaned by hand with less than 505,000,000 of days work at a cost of $505,000,000. By the improved cotton gin, the whole crop can be cleaned by 1,614 men working 313 days, at a cost of not over $500,000.

To shell by hand such a crop of corn as is now raised in Illinois, Iowa, Missouri, Indiana, Ohio, and Kansas would take the whole farming community of those States 100 days, and to shell by hand the 1,300,000,000 bushels, composing the crop of the United States in 1877, would have required the labor of the entire population, every man, woman and child of 40,000,000 of people, for one whole week including Sunday up to 12 o'clock. With a single machine we can shell one thousand five hundred bushels per day.

In this march of progress and improvements, the country grew rapidly in extent, population increased, arts and industries multiplied until the uses for wood and lumber became so numerous and its consumption so great, that to supply the demand with the old methods of manufacture would have been an impossibility.

The 30,000 mills of the country, with their saws and gearing so improved by new inventions that one of them has cut as much as 179,718 feet of lumber in the incredibly short time of two hours and forty minutes, while many of them have a capacity for sawing from 50,000 to 150,000 feet in a day, have been able to supply the enormous demand.

Another exigency was then presented. We were without the means of properly preparing for its many uses, the wood and lumber furnished so rapidly by the improved methods of sawing. By a long and tedious experience we had learned the inefficiency and insuffi-

ciency of the various processes of "seasoning." These could not supply the demand, and after great loss of time, money and material in its production, "seasoned" stuff could not be made to answer the purposes for which lumber was required, without a further preparation at an expense equal to its first cost. The processes of seasoning were at best only the temporary expedients of a former age with which they had passed away.

The necessity, the imperative demand for some new improvement for the proper treatment of wood and lumber was met by the inventor. After long years of study and investigation, an American genius discovered that wood contained within itself certain elements which, by the simple forces of nature, could be made effective not only in its *preservation from decay, but in its perfect development, and thorough preparation for use.* From this valuable discovery, this practical conception, was evolved the process of "Vulcanizing" by which wood of all kinds, of all shapes and forms, can at a small expense *be cured and perpared for all uses, and rendered more useful for all purposes*, and this can be done so rapidly as to supply all demands.

Thus have new improvements promoted progress, progress has created a necessity, and that necessity has brought forth an invention by which the world can grow richer and stronger every day through a new use of the powers of nature.

To the cotton gin, and the electric telegraph, to the reaper, the planing machine, the sewing machine, and other inventions, whose beneficent influences tell with measureless power upon every pulsation of our domestic, social and economical life, we can now add the "art of vulcanizing wood and lumber;" an art,

which by the universality of its application and the magnitude of its results, is entitled to rank with all the great discoveries and wonderful achievements of this remarkable age ; an art, which accomplishes all that inventive genius has sought after for near two thousand years, and which will benefit directly or indirectly every interest within the whole range of civilization.

The Preservation of Wood and Lumber necessary to prevent total destruction of the Forests.

The report of the Department of Agriculture for 1865 contained an able and elaborate article calling attention to the rapid destruction of our forests, which, if not arrested, would at no distant day bring upon the country a national famine of wood with all its calamitous results. The apprehensions of the writer were based upon certain startling facts revealed by the census of 1860. From these he learned among other things, that the annual production of sawed lumber for home consumption and exportation had reached the enormous sum of $95,912,286, being an increase of 63.09 per cent over the product of 1850, while the increase in population had been only 35.59 per cent; that the woodlands were being cleared of their forests at the rate of 3,000,000 of acres every year, or 10,000 acres per day during 300 days of the year. After noticing at some length the vast amounts of wood and lumber consumed in the various arts and industries, in railway and other new enterprises, he ventured the predictions that if for 20 years the demand for lumber should advance in the same ratio with the population, more than $200,000,000 worth of American sawed lumber would be needed every year; that the increase of population which required the timber from 3,000,000 of acres per annum, would then require it from 6,000,000 of acres per annum.

These predictions have been more than verified. The census returns of 1870 showed an annual production

of 12,755,543,000 feet of sawed lumber, valued at more than $200,000,000.

When with the sawed lumber of 1870, we include the greatly increased production of another ten years, and add the immense amount of wood made into shingles, boards, hoops and staves, into railway sleepers and telegraph poles, and into split, hewn, flatted and rounded material for other purposes, and then add all the wood and lumber employed in thousands of uses, of which the census takes no account, we may estimate the amount of wood and lumber now annually produced at 30,000,000,000 of feet; *enough to load* 150,000 *vessels, or* 4,500,000 *railroad cars; enough to build of inch boards a floor* 264 *feet in width around the whole world.*

The increase of population which has brought into requisition such an astounding amount of wood and lumber, is attended with ruinous destruction of the forests in many ways.

The consumption of millions upon millions of cords of wood as fuel upon railways and steamboats, in brick and lime making, and for household purposes, plays sad havoc with broad areas of the most valuable timber lands. In 1875 the small and sparsely timbered State of Massachusetts produced 706,714 cords of fire-wood. In the State of Wisconsin the commissioner of forestry estimates the consumption of fire-wood for household purposes at three cords for each person of the family.

There are in this country six or seven hundred iron furnaces to be supplied with charcoal. Reliable statistics show that sixteen of these establishments in New England annually consume 3,747,489 bushels of charcoal, and sixteen in New York, 2,911,832 bushels, while twenty-three in other States consume 12,202,700 bushels.

From these estimates it is evident that to furnish all the establishments of the country with the amount of charcoal annually consumed requires the growth from millions of acres of forest. Many of these furnaces are located in heavily timbered regions, and already for miles around them the wood is all gone.

Millions of acres of woodland are annually cleared and brought under cultivation. On our widely extended frontier, and even in the older States, in regions remote from market, and without the means of transportation for logs and lumber, many of the finest timber trees are deadened by girdling, while others are cut down, rolled into great piles, and burned into ashes. In every twenty-four hours thousands of acres of grand old forests are thus subjected to indiscriminate destruction.

Fires and tornadoes sweep over the forests of whole States causing devastations which can be measured only by square miles, and losses of timber which can be counted only by hundreds of millions. In a single year forest fires have destroyed as much timber as would be required for ten years of ordinary consumption. They are most prevalent, their damage most extensive in seasons of protracted draught, and by the destruction of the forests draughts are becoming more frequent and protracted.

Such is the consumption of timber, by this wide spread work of destruction, and by its rapid conversion into wood and lumber to meet the unceasing and ever increasing demands of the country, that *twelve millions of acres of forest are swept away every year, or forty thousand acres, every day for 300 days of the year.*

We learn by a well digested report of the forest resources of all the States and Territories, emanating from the Department of Agriculture, that *there are in*

our whole country only 583,366,836 *acres of woodland.*

If forest destruction continue at the rate of 12 millions of acres per year, every acre of this vast area of woodland will be stripped of its timber in 48 years.

The pine forests which have promoted so greatly the arts and industries, and contributed so largely to our welfare, happiness and prosperity, will in a few years be entirely swept away.

Mr. James Little, of Montreal, Canada, in a pamphlet lately published, says, that the State of Maine, once called the "Pine Tree State" of the Union, is now almost stripped of that product. In 1870 Maine furnished 639,167,000 feet of lumber. In that State at the present time there are over 1,099 saw mills "slashing up" spruce and hemlock logs of but six or eight inches in diameter.

New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island, New York, New Jersey, Delaware, Maryland, Pennsylvania, Ohio and Indiana, were at one time dense forests, and within a few years most of those States lying east of the Ohio held large tracts of the finest pine timber. Those States to day, Pennsylvania excepted, are practically denuded of that wood, and with the exception of a small amount of spruce in the Adirondacks, in the State of New York, have little of any description left. Even Pennsylvania, which at one time was one of the best pine-producing States of the Union, is now within a very few years of being stripped of that wood. A significant and alarming fact is, that the coal regions once famous for their pine production, cannot now supply timber props enough for their mines.

The amount of timber now standing in the State of Michigan, according to Mr. Little, can furnish only

17,000,000,000 feet of lumber, which, at the present rate of consumption, 3,000,000,000 of feet annually, would be exhausted in six years.

The future supply which may be expected from Wisconsin and Minnesota, is 32,278,950,000 feet. The present consumption drawn from those States is estimated at 2,500,000,000 annually, which in six years would amount to 15,000,000,000 of feet.

When in six years the pine lumber in Michigan is exhausted, the 3,000,000,000 of feet furnished by that State must be drawn from Wisconsin and Minnesota. Those States would then have to supply 5,500,000,000 instead of 2,500,000,000 feet annually, which would exhaust the balance of the 32,278,950,000 feet in a little over three years, not taking into consideration the number of consumers that will be added to the population in that time.

It will be seen from the foregoing statements that the time is not far distant when Michigan, Wisconsin, Minnesota and other lumber States will be exhausted, and when our sole reliance will be upon the pineries of the South.

In the eleven States comprising what is called the South, there is an area of woodland, of about 235,146,537 acres, embracing pine timber estimated at 11,000,500 cubic feet, or 120,000,000,000 of feet inch measure, which amounts to more than all the white pine and spruce this side of the Rocky Mountains. There is already a heavy drain upon the Southern pineries to supply domestic and foreign demands and their lumber bearing capacity is greatly reduced by the operations of the turpentine farmers. When the pine timber of Michigan, Wisconsin, Minnesota and other States is all gone, and when the pine

forests of the South are drawn upon for the amount of lumber hitherto supplied by the exhausted States, they too will be in a few years destroyed. In the opinion of Mr. Little *a single decade will make a clean sweep of every foot of commercial (pine) wood in the United States this side of the Pacific slope.*

The danger of a wood and lumber famine in this country is indeed becoming alarming. We can now appreciate the wisdom and foresight which inspired the serious and important warnings, which fifteen years ago, were sent out from the Department of Agriculture.

When by the extinction of our noble forest growth the supplies of wood and lumber necessary for all the arts and industries are cut off, disaster, direful and universal disaster, will fill the whole land. The wide spread ruin from commercial revulsions, and wars' desolations will appear as of little importance compared with the terrible calamity which a dearth of timber will bring upon the country.

Political economists, legislators and the press begin to realize that the future welfare of the nation is imperiled. They have become alarmed, and are suggesting measures to avert the threatened evil. Laws are being passed looking to the protection of existing woodlands, the encouragement of tree planting and forest culture, the prevention of fires, and of the wanton destruction and waste of timber.

The most effective method of protecting the forests of the country, is to prevent the constant and universal destruction of wood and lumber by decay.

Growth is slow, restoration tedious, destruction by decay is rapid. With all the encouragement and protection which may be afforded by legislative enactments

the production of timber cannot be made to keep pace with its destruction by decay.

Time for growth and restoration of the forests can be gained by diminishing the consumption of timber, and the consumption of timber can be diminished *by the preservation of wood and lumber from destruction by decay.*

It is said that the pineries can never be replaced; that it takes a century to grow a standard pine log 22 inches in diameter, and that full grown pines represent hundreds of years of growth. Nevertheless planting should be encouraged, and the man who makes two trees grow in place of one should be considered a public benefactor. The man who, by preventing decay, makes one tree last so long as to save the cutting of many, should also be considered a public benefactor.

The rotting of railroad ties, of telegraph poles, of wood and lumber in its numberless other uses, and in all its shapes and forms, creates an annual demand for timber, which can only be supplied by an exhausting drain upon the forests. *The most practical method of saving timber, and of preventing a total destruction of the forests of the country is to use "vulcanized" wood and lumber for all purposes.*

When our forests are being destroyed and our timber supply exhausted so rapidly that the country is threatened with the calamity of a wood famine, it will be found that the "Art of Vulcanizing," *by which wood and lumber can be cured and prepared for use, can be developed and strengthened and made more useful, and at the same time preserved from decay and rendered more durable for all uses, is "the Most Valuable Discovery of the Age."*

[From New York Sun, Feb. 5th, 1881.]

THE TIMBER LANDS OF MICHIGAN.

In to-days *Bradstreet's*, information concerning the lumber trade in Michigan shows that in the Saginaw Valley the capacity of the sixty-seven mills in operation is now 923,000,000 feet in a year. In 1872, it was thought that the mills of the valley had reached the limit of their production, but statistics show that the output for that year has been exceeded four times. The proportion of stock sold to that unsold at the close of last season was not as great as in the year previous, but was far greater than that in 1878, and in comparison with the records of previous years makes a favorable exhibit.

Heavy firms and syndicates are buying the pine lands, and it is believed that before long the lumbering interests of Michigan will be in the control of a few individuals and firms.

In the Lake Huron Shore district are twenty-six mills, with a day capacity of 310,000,000 feet a year. It produced 23,728,391 feet less than in 1879. Green Bay has thirty-four mills, with an increase in production, compared with 1879, of 102,533,488 feet. In all there are 523 large lumbering mills in the State.

The exact amount of lumber manufactured in Michigan in 1880, was 3,769,166,329 feet. The amount of increase over the production in 1879 is in round numbers 658,000,000 feet, and that of 1879 over that of 1878, 651,000,000 feet. As to lumber on hand, there is 886,617,679 feet in Michgan, this being an excess over the surplus in 1879 of 209,290,761 feet. The number of shingles made last year is 2,428,659,230, and is in excess of the production of 1879 by 370,574,480 shingles.

The introduction of railroads has changed the nature of logging in the past five years. The supply is regulated by anticipated demand. When spring opens a larger quantity of logs will be floated than ever before in one season. It is estimated that 3,885,000,000 feet have been banked this winter.

A lumberman computes that there are standing in Michigan 44,000,000 000 feet of lumber. At the present rate of destruction, these forests would last only eleven years. The land, however, is good for farming.

[From the New York Sun, May 5th, 1881.]

The necessity of doing something to replenish our rapidly diminishing timber supply becomes more apparent with each year's report from the forests of the North-western States. The quantity of lumber felled during the season just closed in Michigan, Minnesota, and Wisconsin was over six billion feet. The logging next summer will increase this to seven billions and a half. At this rate of encroachment, the supply of timber will not last a dozen years. A lumber famine is plainly near at hand, unless practical steps are taken to prevent it.

By proclamation of the Governor of Michigan, the 25th of April has been made a public holiday, to be known as Arbor or Tree Planting Day, and efforts are to be made to have it generally observed every year in the manner indicated by its name. It is expected that the Governors of other States will take similar action. If this serves to interest the people thoroughly in the question, and to awaken them to its importance, it will help toward averting a serious danger.

[From the Baltimore Sun.]

PRESERVATION OF TIMBER.— The United States, for its area, is probably the best wooded country in the world. Still, an examination of the maps in Professor Walker's statistical atlas to accompany the last census will convince every one that in more than one-half of the entire country the woodland does not exceed an average of sixty acres to the square mile. Experience has taught even our wasteful lumbermen and timber-getters that our woodland is far from being inexhaustible, and the practice current forty years ago of clearing up wooded tracts by "deadening" the timber and burning it when seasoned for potash has pretty much been abandoned. In the treeless, rolling prairies west of Missouri the practice now is for State, county and local authorities to give every encouragement to tree planting, and, under the modified homestead law, in some sections government land may be taken up upon the simple condition of planting forest trees on a certain proportion of it. Nevertheless, these are only partial provisions against a continually increasing diminution of our valuable timber areas, and our hard woods, as well as our coniferous forests, are being cut down much more rapidly than they can be made to grow up again. The statistics of the consumption and waste of timber in the United States present a startling aggregate. Our fences alone, according to Mr. Dodge, late statistician of the agricultural bureau, have cost our people $1,700,000,000, nearly half of which consists in value of

material, and the annual cost of repairs is estimated at $198,800,000 towards which Maryland alone contributes $2,000,000 and New York $12,000,000. An iron furnace that burns charcoal, if in full blast, will consume all the wood around it for three miles. Our railroad fences have cost $4,500,000. Our friction matches alone demand 230,000 feet of pine lumber annually, and our shoe-peg makers use up a million dollars' worth of white birch every year. It needs the wood upon 98,000 acres to supply the annual demand of our railroads for ties. It is estimated by Hon. George P. Marsh and other competent and careful observers that at the lumberman's estimate of 333,000 feet of lumber to each 40 acres our total consumption of timber for all purposes would demand the clearing of twelve million acres of woodland every year. This is an area equal to that of Vermont and New Hampshire combined. Anything that will tend to check this enormous destruction of woodland must be welcomed on all hands as a great national boon. The maps referred to in General Walker's atlas show very strikingly that our treeless waste corresponds almost line for line with the sections where the rainfall is totally absent or very deficient. Forests, whether they promote the aggregate rainfall or not, certainly husband the waters of the streams which bind upon them, modify climate beneficially, protect lands from winds, increase the grass crops, and add to the fertility of soils. Hence the importance of every measure or improvement which tends to check the destruction of timber. Good forestry laws (not "stumpage" regulations like those recently put forth by Secetary Schurz) and laws for the encouragement of planting in treeless areas will always be acceptable. We must of course do nothing to check or obstruct the vast and varied industries which find scope in the preparation, transportation and manufacture of our diffierent hard and soft woods, but it is perfectly right to promote experiments looking to the preservation of timber in use. Thus, take the case of railroad ties, which survive only five years on the average. Any process by which the life in use of a railroad tie or a fence post, or a sill or telegraph post, or a wharf pile, or any other piece of timber that is brought in immediate contact with the earth or the water may be doubled or extended materially, will be the greatest possible relief to our overtaxed woodlands. A great many experiments have been made and are still making by governments and private persons also to find out how timbers may be prevented from decay and protected from the ravages of insects; but no cheap universal medium to effect this has yet been found. In the case of the teredo and its ravages some careful experiments made at Amsterdam and elsewhere in Holland seem to have proved that creosote is a nearly perfect preventive. But no practicable, cheap means are yet known by which a chestnut post, for instance, which rots off in fifteen years, may be kept sound for thirty.

The "VULCANIZING" Process will preserve from decay "*a railroad tie, a fence post and board, a telegraph post, a wharf pile, and any other piece of timber or lumber brought in contact with the earth or water, and will afford the desired relief to the overtaxed Woodlands.*"

[From the Baltimore Sun.]

THE CONSUMPTION OF LUMBER in this conntry is enormous, altogether beyond what is generally supposed. The annual demand for ties and sleepers of our 90,000 miles of railway is estimated to be 60,000,000 square feet, and to inclose the roads would require 180,000 miles of fence. We have 75,000 miles of telegraph wire to put up, for which 3,000,000 trees are needed, while repairs would need near 300,000 more trees a year. The common lucifer match uses up 300,000 cubic feet of the finest pine annually. The bricks baked every year require 3,000,000 cords of wood, which would be all that 50,000 acres of average timber-land would contain. Shoe-pegs exhaust annually 100,000 cords of wood; last and boot-trees some 500,000 cords of beech, birch, and maple, and about as much more is required for the stock of planes and other tools. The packing-boxes made in the United States in 1874 cost $12,000,000, and the lumber manufactured into wagons, agricultural implements, etc., was worth over $100,000,000. An immense quantity of lumber is employed for fences of houses and farms. Our consumption of lumber increases steadly and so do our foreign shipments, our exports of pine, maple, walnut and oak being very large. Immense as our resources are, the supply must ere long be exhausted.

[From the Rochester Democrat.]

HOW OUR FORESTS ARE USED UP.

Our forests are rapidly going, while no adequate provision is being made to restore them. The State of New York has a great park full of timber in the northern wilderness, but annual fires are making havoc in that region. The great woods are probably loosing more than they gain from annual growth. Wood is becoming more scarce and inaccessible every year. . In many States the forests on level ground have mostly disappeared, and only remain upon high hills or monntains, which are not easily accessible. The *Monetary Times* tells how the forests disappear:

To make shoe pegs enongh for American use consumes annually 100,000 cords of timber, and to make our lucifer matches, 300,000 cubic feet of the best pine are required every year. Lasts and boot-trees take 500,000 cords of birch, beech, and maple, and the handles of tools 500,000 cords more. The baking of our bricks consumes 2,000,000 cords of wood, or what would cover with forest about 50,000 acres of land. Telegraph poles already up represent 5,000,000 trees, and their annual repairs consumes abont 500,000 more. The ties of our railroads consume annually thirty years' growth of 75,000 acres and to fence all our railroads would cost $45,000,000, with a yearly expenditure of $15,000,000, for repairs.

In the North-west there has been a very rapid destruction of the forests, and much solicitude is felt as to the fnture source of timber supply.

[From the New York Sun.]

There is in Massachusetts a society for the promotion of agriculture which seems to be going about its work in the right way. It has lately taken in hand the encouragement of tree planting, which is a matter deserving of more attention than it is receiving from the tillers of the soil. The annual devastations of our forests are going on at a rate which excites the alarm of the men who have most carefully studied our supply of timber. We find in the Springfield *Republican* some interesting statistics on this subject. Our railroads annually consume for fuel alone a quantity of forest trees representing twenty-five years' growth on 350,000 acres. Railroad sleepers use up thirty years' growth on 100,000 acres. Fences to enclose the railroads clear as many acres more. Telegraph poles for 65,000 miles of telegraphs require the felling of 2,600,000 trees, and the annual repairs 250,000 more. For matches alone there are annually sawed up 230,000 cubic feet of wood. In 1870, 36,000 acres were stripped for brick making. Shoe pegs take 100,000 cords of white birch annually. In 1870, for pine packing boxes and for wooden ware, vast quantities of valuable timber were used, and sawed logs footed up in value to over $103,000,000. Add to this voracious demand that made for ordinary fences and firewood, and to that add the wanton destruction of forests for mere clearing, when sometimes the timber felled subserves no useful purpose, and we begin to get some idea of the rapidity with which our forests are disappearing, and to discover the reasons for the solicitude for the future felt by those who have most carefully studied the subject of the destruction of our growing trees.

[From the Baltimore Sun.]

IMPORTANCE OF FOREST PRESERVATION.

It was mentioned in late Washington special dispatches of "THE SUN" that the commissioner of agriculture has addressed a letter to the President recommending an appropriation of $8,000 to prosecute during the next year the inquiries into the subject of forestry which were begun last year under the auspices of the department by Dr. Hough, of New York. It is said with truth that the question of timber culture and timber preservation, not only on the public but on private lands of the United States, is one of the most difficult and one of the most interesting problems that can attract our attention. It is not too much to say that not any nor all of the important questions which must be considered by Congress at this session are of greater paramount concern to the people of the United States than the adoption of measures for the preservation and renewal of our forests. There is not a single subject before Congress so closely connected with the increase of our national wealth, the salubrity of our climate, the production of the soil, and the other wants of society, and which has received so little of the fostering protection of the government, as the forests of our country. Europe, in its forest laws, is far ahead of America, and is in less danger at this moment of becoming a desert than the United States are, unless something prompt and effective is done to arrest the wholesale destruction of timber which is still going on in all parts of this country. It has been truly said that growth is slow and restoration tedious, while destruction is rapid and injury instantaneous. Palestine and Syria, Egypt and Italy, France and Spain have seen some of their most fertile lands turned into deserts by the destruction of the forests.

There are parts of Asia Minor, of Northern Africa, of Greece, and even of Alpine Europe, once covered with luxuriant woods, verdant pastures, and fertile meadows, which have now become so completely desolated as to be rendered an unfit abode for man. We are really in danger here of such a result in some sections of the country unless intelligent and immediate measures of remedy are adopted. The evils of past destruction have been a great increase in the cost of fuel, in the price of lumber and timber, hindering the erection of dwellings and rendering furniture very expensive, and the high rates of fares and freight charges on our lines of travel and transportation, from the increased cost of building and equipping steamboats and railroads. Cheap bread, cheap houses, cheap fuel and cheap transportation of passengers and freights are fundamental to the material growth and prosperity of a nation. All these are hindered by the havoc now making in our forests. The consumption by building railroads, for railroad fuel, the general consumption of wood for fuel in the country, the consumption by mechanical industry, the destruction by

war, by improvident waste, and the destruction by farmers who, when wood commands a high price, cut down their choicest trees, are among the causes which threaten the noble forest growth of America with extinction. No private efforts can meet the emergency. Congress and the State Legislatures should afford every facility for the proper understanding of the subject, and for the adoption of the most thorough means to prevent what threatens to become eventually a national calamity.

[From the Cincinnati Gazette.]

THE PINE FORESTS OF MICHIGAN BEING RAPIDLY EXHAUSTED BY THE LUMBERMAN.

ALPENA, AUG. 7.—Alpena is one of the many Michigan towns that are springing up along the lake shore at the mouths of rivers whose tributaries flow through the great pine forests of the State. Every river throughout the constantly receding timber belt of Michigan, now reaching from the Saginaw Valley to the Straits of Mackinaw, sufficiently large to float a raft of logs, becomes a highway between the lumber camps, wherein motley crews of men, gathered for a few winter months from all nations of the world, rob the forests of their precious pine. The time is near when the pine, hoarded by nature for ages within the bosom of her forests, will be exhausted; when the rough woodsman will have departed to other lands; when the sawmills, now bustling with life, will stand silent and deserted. What is to be the future of this region when that time shall arrive? Is it to remain a useless waste, awaiting the slow restoration of its forests? It is certain that the agricultural value of the land stripped of its pine is proving to be much greater than was formerly supposed. Clearings are being made, and good crops of wheat, oats, hay, and potatoes raised. A tide of emigration in this way is following the woodchoppers and converting the mutilated forests into prosperous farms. When the terrible forest fires of Michigan swept over 10,000 acres of fine land along the Lake Huron coast, south of Saginaw Bay, and destroyed whole towns, many lives, and millions of dollars worth of property, the lumbering interests were utterly destroyed. Not a single mill, I am told, in all that region has since been built. It was thought the fire had ruined the future of the burned district, and that it would be thenceforth valueless. These fires occurred the year of the Chicago fire, just ten years ago, and to-day this burnt district is said to be the finest farming region of the State.

The destruction of the pineries of Michigan, Wisconsin, and Minnesota is a matter of importance. How long will the forests of these three States that contain the chief stores of pine timber on this continent east

of the Rocky Mountains continue to supply the enormous drains being made upon them? One example will show how rapid is the process of destruction. The Saginaw Valley formerly contained the largest and finest pine forests in the State of Michigan. Mill after mill was built along the banks of the river, until their united capacity reached 600,000,000 feet of lumber per year. To supply these mills the pine in the Saginaw Valley has been already in great part exhausted, and mill owners are obliged to bring logs from other rivers, often as far as 150 miles distant, to supplement the stock of the Saginaw river. The output on that river has reached its climax. No more new mills are built or old ones replaced. The business must gradually diminish in volume until the Saginaw Valley, now the greatest lumber district in the world, shall hear the buss of the saw no more.

Talking to a gentleman of Alpena, who has witnessed the growth of the lumbering business of that place almost from its commencement and whose business for years has kept him accurately posted as to the quantity and location of the pine in the Alpena district, he said that, dividing the number of millions of feet of pine timber tributary to the Alpena river by the annual capacity of the Alpena mills, it gave them fifteen years supply. These figures agree very closely with those given me a few weeks ago by the president of the largest logging company on the Mississippi river, operating in the Wisconsin pineries, a region that has been worked much less extensively than the Michigan pineries. They would last, he said, thirty or forty years. The Minnesota pineries are not so large as either of the others, and will probably not survive them. In from twenty-five to forty years the last tree will be cut, and the entire country from Maine to the Rocky Mountains must learn to live with meagre quantities of pine lumber brought at a great expense from distant countries.

The pineries cannot be replaced. A full grown tree represents hundreds and hundreds of years of growth. I saw small pines, no larger around than a man's arm, bearing the scars made by the axes of the United States Engineers thirty-five years ago. What ages, then, must be required to produce a tree three or four feet in diameter? When these forests reach the condition of the pineries of Maine and New York, and become extinct, no new ones will take their places. The American of the near future must learn to hew and build without pine, and marvel at the thoughtless recklessness of his ancestors.

[From the New Orleans Times.]

NECESSITY OF PRESERVING OUR WOOD.

The rapid destruction of the forests of this country is beginning to force itself as a great fact upon public attention. In the last report of the Agricultural Bureau an earnest appeal is made to the people of the United States to arrest the destruction of our forests by planting young trees, so as in some degree to make production keep pace with decay. It must be admitted that timber of various kinds takes rank as a necessity in the arts and industrial requirements of humanity, and statistics show that in the first settled portions of this country wood is becoming extremely scarce and valuable. These older settlements are now drawing their supplies from the newer States, and in this manner the whole tree-bearing territory of the country is in process of being gradually denuded of forests, which should serve the double purpose of supplying a recognized necessity in civilized as well as savage life, and of attracting, preserving and distributing the moisture on which fertility depends. Not only our own people, but foreign nations, have become the consumers of our forests, our oaks, pines and other trees beings shipped in large quantities to England and the European continent. A single gun-factory in Europe is said to have consumed, during the first two years of our late civil strife, no less than 28,000 walnut trees in the manufacture of gun-stocks, all of which were shipped from this country as timber, and were returned here in their new form as parts of deadly weapons. During the decade between 1850 and 1860, fifty milllion acres of land were, within the limits of the United States, brought into cultivation. Of the vast tracts this immense number of acres represents, two-thirds are supposed to have been originally timbered, but are now no longer timber-producing. The uses to which lumber is applied in buildings, fences, fuel and furniture are, however, inconsiderable compared with the waste and intentional destruction of forest trees by frontier encroachment; and when we take into consideration the fact of our rapidly increasing population, in connection with another fact, to wit: that a large portion of our domain is naturally treeless, or prairie land, it is by no means difficult to anticipate a time when a wood famine will prevail throughout our boundless continent, unless remedial measures are in time adopted. These should consist not only of legislative measures to secure the planting of trees and the preservation of forests, but the application of such scientific principles and processes as will increase the durability of wood. The enormous quantities of wood required for railway sleepers, bridges, fences, wharves and other purposes, considered in connection with the known rapidity with which the kinds of wood commonly employed for such purposes, decay, renders it of the utmost importance that the durability of woods be, if possible, increased.

It is well known that timber, employed for certain purposes, has in England been subjected to a certain process which preserves it from decay, even as the flesh of animals is preserved by salts and chemical combinations. This process, applied to railway ties and bridge timber, in 1839, proved completly effectual. After twenty-five years of exposure it was found "perfect as newly-sawed lumber," such being the verdict of the judges of *Exposition Universelle.* The process employed is called the Bethell process, but it is understood that one, not only cheaper but equally effectual, has been discovered in this country, by which wood is preserved from natural decay, as well as from the attacks of sea worms, so destructive to wharves and the bottoms of wooden ships. In no quarter of the world does wood decay more rapidly than in New Orleans. Our wharves, bridges and fences have to be renewed every five years, at great cost and inconvenience. If they could, by a cheap process of preparation, be made to last for twenty-five, thirty or forty years, the advantages would be almost unspeakable and the means of averting the threatened wood famine would be apparent.

HOW TO SAVE OUR FORESTS.

BOSTON, Aug. 30.—The American Association for the Advancement of Science met in general session in Huntington Hall, at 10 A, M. Cincinnati was selected for the next meeting of the association, which will begin on Aug. 17, 1881. The committee to memoralize Congress and State Legislature upon the cultivation of timber, reported through Dr. Franklin B. Hough of Lowville, N. Y. The report was accompanied by a draft of a memorial, which invites the attention of State Legislatures to the great and increasing importance of providing by adequate legislation for the protection of the existing woodlands of this country against needless waste, and for the encouragement of measures tending to a more economical use and proper maintainance of our timber supply, it being evident that the forests of the country are being used and wasted in a much greater degree than their restoration by natural growth. The committee recommend a law to protect trees planted along highways, and to encourage such plantings by deductions from highway taxes; also the passage of a law that shall exempt from taxation the increased value of land arising from the planting of trees where none were growing for such period as may appear proper, or until some profit may be realized from plantation; by appropriations of money to agricultural and horticultural societies, to be applied as premiums for their planting and for prizes for the best essays and reports upon subjects of practical forest

culture; by encouraging educational institutions to introduce courses of instruction having reference to practical sylviculture; by laws tending to prevent forest fires: by imposing penalties against wilful or careless setting of such fires, and enlarging and defining the powers of local officers in calling for assistance and in adopting measures for suppressing them; by establishing under favorable circumstances model plantations; by the appointment of a Commission of Forestry under State authority analogous to the Commission of Fisheries.

[From the N. York Sun.]

THE GREATEST DAMAGE DONE BY FIRE.

If the town officers in the portions of the country which suffer from forest fires lend proper assistance, the tenth census will contain statistics concerning those conflagrations that may prove of the greatest value as a guide to legislative efforts for preventing the destruction of our growing timber by accidental fires.

At the instance of Mr. C. S. SARGENT, who has charge of the statistics of forestry, the Superintendent of the Census has issued a circular to such officers asking for particulars as to the area burned over and the value of the property destroyed during the year 1880 and during the last ten years, and as to the causes of the forest fires in each town. Suggestions as to methods for the prevention of the fires are also sought by this circular, which should command the most careful attention of every town officer who receives it.

Few people have any proper conception of the magnitude of the damage annually done by these forest fires. In a dry season, like last summer, for instanee, they often burn up timber of millions of dollars in value. The total of the immediate loss they occasion in the destruction of buildings and growing crops, as well as of timber, is sometimes greater than that brought about by any of the other conflagrations of which we have had experience, even those that laid waste Boston and Chicago. The vast forest fires of 1871 in Michigan and Wisconsin alone caused a pecuniary loss estimated at hundreds of millions. Including both woodland and prairie, the fires of that year swept over thousands of square miles, and destroyed not only forests, but also villages and cultivated farms. Such fires have of recent years devastated many thousand acres in New York, New Jersey, and Pennsylvania, and occasioned a loss in timber alone which aggregates millions more.

In a single year forest fires have destroyed as much timber as would be required for the ordinary consumption of the country for ten years. And yet that is only the first loss. We must add the incalculable prospective damage done the land over which the fires have burned. They generally leave it in a condition which prevents it from again nourishing valuable species of timber until after many years have passed. Instead of the fine timber destroyed, inferior growths appear. The calcined soil refuses to sustain better species than scrub oak or some other worthless variety of tree.

All through the South, for instance, hard pine is being replaced by an almost useless species, owing to the annual practice of burning over the forests to improve the miserable pasturage they yield. In our Northern States the white pine and the hemlock do not again grow on land previously burned over. In this State regions once covered by pine forests are now barely able to support huckleberry and blackberry bushes, so frequent have been the fires.

This enormous loss is occurring at a time when the legitimate demands upon our timber were never so great, and when it is obvious that our timber supply can only be kept sufficient for our needs by the greatest care in preserving and replacing our forest. Moreover, instead of diminishing with the advance of civilization, the fires are rather increasing. There is more danger of them from the sparks of passing locomotives and from the carelessness of the multiplying population. Last summer the fires were especially destructive, and they are sure to rage to some extent every summer, and to a great extent when the season is dry and the winds favorable.

It is intended to make the tenth census more complete than any taken before in its information as to our forests. The subject is one in which a much greater degree of intelligent interest is shown than it formerly received, for the necessity of efficient measures for the preservation of a proper proportion of woodland begins to be better appreciated. The wanton waste of valuable timber in the making of clearings, in fencing, and in obtaining firewood, needs to be checked; but the greatest enemy of our forests is fire. How to prevent these forests fires is one of the most serious of questions. We hope, therefore, that the town officers of whom information is sought for the census will take due pains to furnish full and accurate facts regarding them, and so supply Mr. SARGENT with the data for a thorough study of the whole important subject.

[From the New York Evening Post].

THE FUTURE OF THE COUNTRY.

We are rapidly using up our timber. It requires no prophet to foresee the time when the forests upon which we now rely will no longer exist. If matters go on as they are going wood for all purposes will become scarce and high in this country long before the boys and girls now in school shall become old men and women. To say that we shall thus lose a source of great annual profit and shall increase the cost of every manufactured article into the construction of which wood enters, thereby enhancing the expense of living to every family in the country, is to tell only a part of the story of the future, and a minor part at that. The major part is a fearful looking-for of judgment, a new cursing of the ground worse than the first; for while the primal curse bade the earth bring forth thorns and weeds, the curse with which we are threatened will forever forbid it to bring forth any vegetation at all.

Scientific observation shows conclusively that land stripped of trees deteriorates in a fixed course, from rich loam to sandy loam, and from sandy loam to sand, arid and beyond redemption. There are just two steps from the cornfield to the desert, from a garden to Sahara. There are parts of Asia once covered with heavy forests, in which acorns now rot and wither where they are planted; districts once as fertile as our own plains which are now barren and desolate beyond the power of any fertilizer to redeem them. The history of those districts will be repeated in that of our own plains and mountain sides if we continue to invite desolation as we do now.

The evil is double headed. We sin against nature both in what we do and in what we leave undone. Without doubt we waste timber wantonly and use it recklessly; but we are guilty of equal fault in our neglect to plant new trees with which to make good the waste and the necessary consumption. There are lands in every country — we may safely say in every township — in these Eastern States which have already descended almost to the condition of desert wastes. They are not yet beyond redemption, but we are doing nothing or nearly nothing to redeem them, and it will soon be too late.

To avert so dire a disaster as that which threatens us is surely a task worthy of the attention, the earnest, even the enthusiastic activity of men whose concern for the future welfare of this land of ours is manifested so encouragingly in political affairs, and it is to awaken such men to a sense of the danger and the duty that we return to this theme time after time. If such men can be induced to give to the duty a tenth part of the attention which they devote to their political duties the dangers will be averted.

[From the Des Moines Register.].

IOWA BLACK WALNUT CARRIED TO ENGLAND.

The lumber dealers of England are making a grand raid on Iowa and all the black walnut States, and are fast taking from us all that we have left of that timber. The native forests in Ohio and Indiana were rich with this now precious wood, and the early settlers of those States, in clearing the land for agricultural purposes, destroyed numberless thousands of acres of the timber. It is estimated that if the States of Ohio and Indiana stood covered now with their native forests they would be worth more in actual value than as they stand to-day.

The traveler along the railroads of Iowa sees now, at nearly every important station, a little out-door steam saw mill working away like mad, ripping up black walnut logs into great slabs. All over the West, in the black walnut belt, these little saw mills are cutting up into a certain form of broad and thick slabs all the black walnut that can be got hold of. A large and wealthy corporation of Indianapolis men, coöperating with a company of English capitalists, are the proprietors of these mills. They have their buyers out at every little station and in the rural districts, and wherever the smallest patch of black walnut can be found. Two of these little mills are now tearing away in the city of Des Moines, and another at Mitchellville. All that we have left of this valuable timber in Polk County and Central Iowa is fast passing under their saws, coming out broad slabs, and going thence directly on the cars on their way to England, where, in their greater wisdom, the people have come to know that black walnut wood is already as valuable, because of its durability, beauty and scarcity, as mahogany.